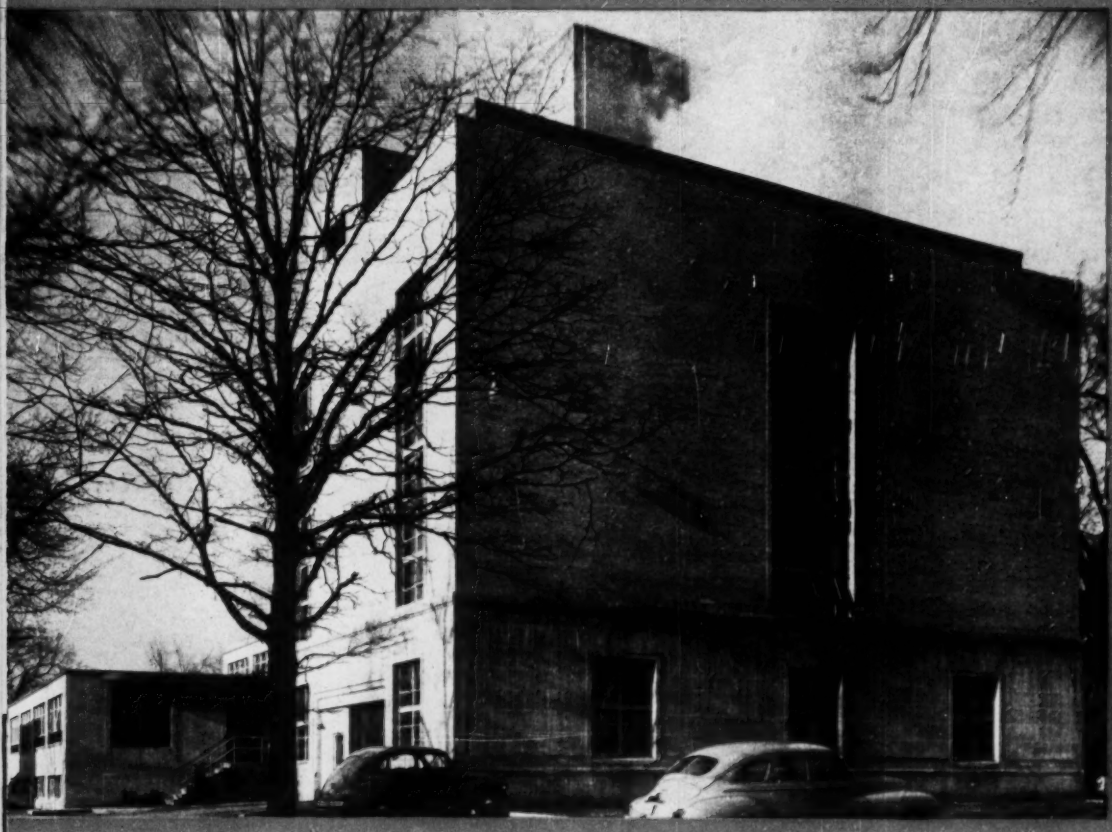
# Heating Piping & Air Conditioning

DESIGN
INSTALLATION
OPERATION
MAINTENANCE

JULY ★ 1950

INDUSTRIAL
COMMERCIAL
INSTITUTIONAL AND
PUBLIC BUILDINGS

*Page 113—Journal Section of the American Society of Heating and Ventilating Engineers*



*New central heating plant serves Oberlin College....page 84*

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**How to Use Evaporative Cooling .....96**

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*Complete contents of this issue—page 5*

# ADJUSTABLE PIPE HANGERS AND SUPPORTS

## for every piping requirement

NO. 1 OF A SERIES SHOWING THE GRINNELL LINE

### Malleable iron rings for fire protection, plumbing and heating up to 450°

**fig. 104**
swivel ring
split ring type
¾" to 8" pipe

**fig. 101**
swivel ring
solid ring type
¾" to 8" pipe

**fig. 101B**
swivel ring
with boss
solid ring type
(optional)
2" to 8" pipe

**fig. 150**
swivel ring
solid ring type
¾" to 8" pipe

**fig. 97**
wrought ring
malleable nut
½" to 8" pipe

**fig. 95**
wrought ring
flattened end bolt
½" to 8" pipe

**fig. 108**
split ring
(ring only)
½" to 8" pipe

**fig. 107**
split ring
with socket
½" to 8" pipe

**fig. 115**
split ring
with turnbuckle
adjuster (optional)
½" to 6" pipe

**fig. 138**
extension ring
tapped I. P. S.
⅜" to 3" pipe

**fig. 105**
clip ring
¾" to 2" pipe

**fig. 232**
pear shape ring
½" to 6" pipe

### steel clamps for high temperature process and power plant service

**fig. 224**
forged alloy clamp
4" to 16" pipe

**fig. 212**
wrought clamp
1½" to 24" pipe
(heavy duty, fig. 216
3" to 16" pipe)

**fig. 295**
wrought clamp
double-bolt
1½" to 24" pipe

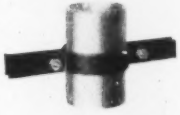

**fig. 261**
riser clamp
¾" to 20" pipe

**fig. 260**
wrought clevis
¾" to 16" pipe

**fig. 269**
wrought band
¾" to 8" pipe

*Write for Hanger Catalog 10-D.*

# GRINNELL

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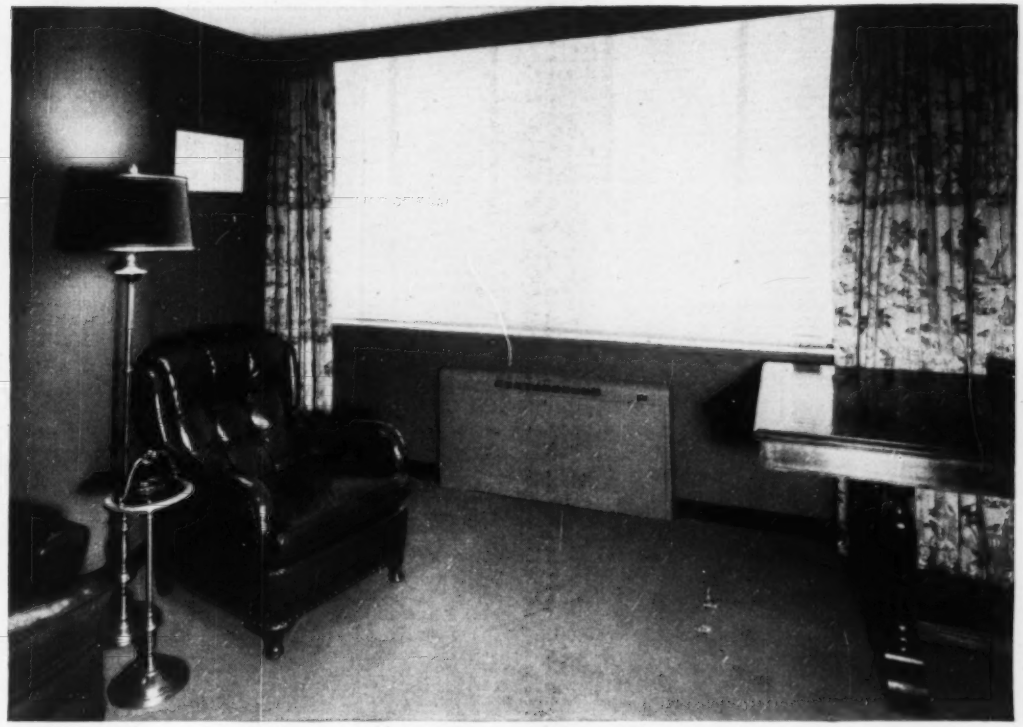
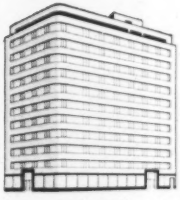


# How they air conditioned the Kaymount Building ...without the use of tin snips!



The new Kaymount Building, corner of Vermont and K Street in Washington, D. C., is everything a modern office building should be.

Its streamlined exterior is matched by an interior carefully planned to make every inch of space useful and profitable. So when it came to putting in the air conditioning, the Kaymount builders threw away their tin snips and any notions of cluttering the building with ductwork. They selected a system as modern and efficient as the building design itself . . . usAIRco Modu-aire, the ductless way to air condition multi-room buildings.

Equally valuable in a 4-room school or a 1000-room hotel, Modu-aire offers individual room units combining blowers, coils and filters. Cooling or heating is piped to each unit from a central system through small copper tubing. The desired temperature and humidity is mixed and controlled in each room by the tenant.

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. . . wire or write United States Air Conditioning Corporation, Minneapolis 14, Minnesota.

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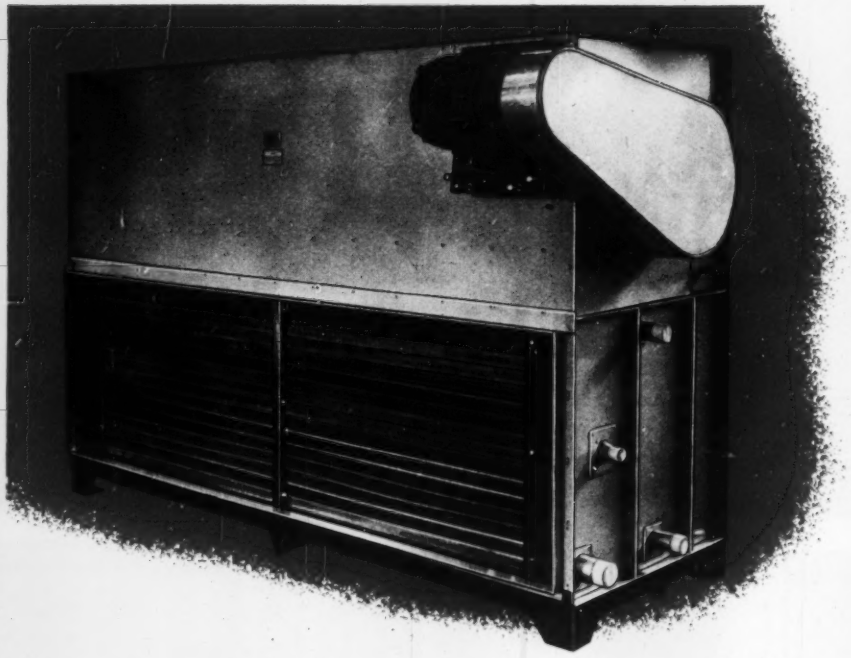
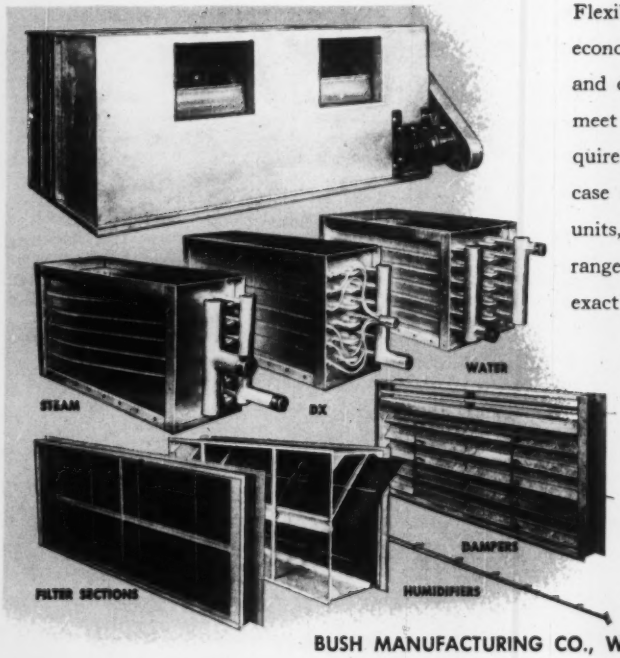
WITHOUT DUCTS!
Engineers and manufacturers of air conditioning, refrigeration, unit heaters, coils and ventilating equipment



**VERTICAL AIR HANDLING UNIT**
Illustrated (left) available with face and by-pass dampers, choice of either flat or V-type filter sections with throw-away or cleanable type filters, humidifiers, and wide variety of coil selections.

# *Air Handling* UNITS BY BUSH




Flexibility of component parts assures efficient, economical delivery of filtered air . . . cooled and dehumidified or heated and humidified to meet the all-year-'round air conditioning requirements of products or personnel. Eight case sizes, in either floor or ceiling mounted units, are available . . . with an overlapping range of air deliveries to meet specifically the exact demands of any application.

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**BUSH MANUFACTURING CO., WEST HARTFORD, CONN.**

# Heating Piping & Air Conditioning

(with which is merged the Aerologist)

DESIGN, INSTALLATION, OPERATION, AND MAINTENANCE IN INDUSTRIAL, COMMERCIAL, INSTITUTIONAL, AND PUBLIC BUILDINGS



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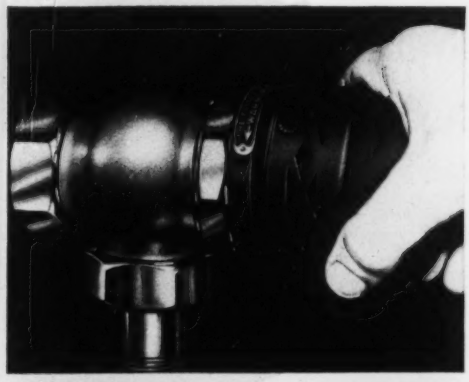
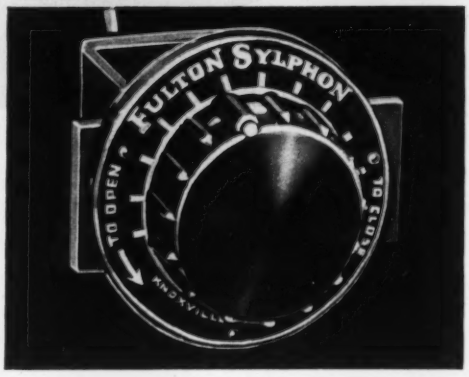
# *Set it... forget it!*

## Sylphon AUTOMATIC Comfort Control for every room— saves fuel, boosts efficiency






*Illustrated—two basic types of Sylphon automatic radiator valves. Top, for exposed radiators. Below, for enclosed radiators. Both available in globe and angle bodies. Thermostatic member of each is an accurate, dependable Sylphon seamless metal bellows assembly.*

*"Everything's under Control"*

HERE'S a point that should set every plant or building operator thinking now about winter heating costs and employee efficiency. Studies of weather reports show that *during 95 per cent* of the average winter season, more heat is generated than needed for health and comfort.

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They're small and neat, require no complicated piping, wiring or auxiliary equipment. They're self-powered, packless, and fully modulating. They can be easily installed on your present equipment. And—they pay for themselves many times over in fuel savings.

Plan installations *now* . . . get set for winter. Write for complete information. Ask for free Bulletin NH-738.

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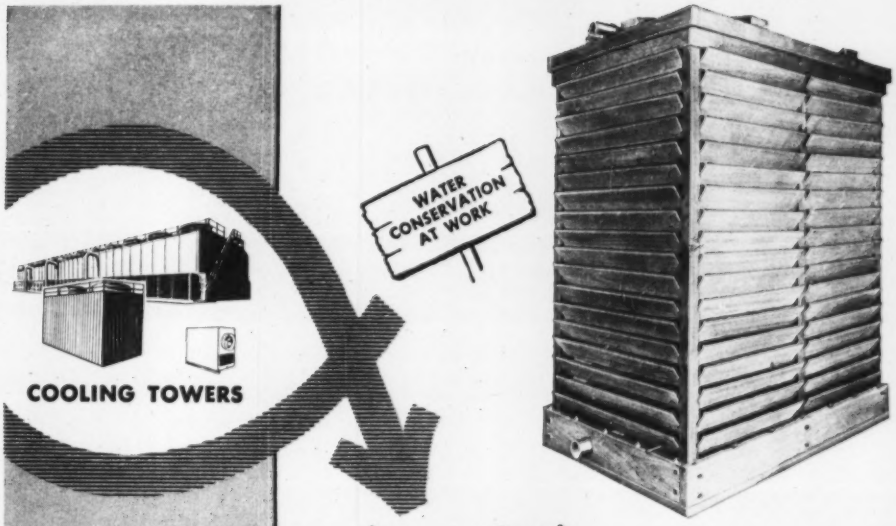
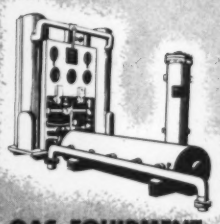
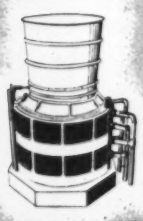



*Here's Why*

# You'll Want to Specify *The* Pritchard "SRF" TOWER!




*Low cost* Pritchard Series "SRF" Cooling Towers are especially designed for air conditioning or refrigerating installations requiring 3 to 24 tons capacity. Louver boards, louver posts and top framing are made of finest California Clear-Heart Redwood for *long life.* Steel pipe distribution system assures efficient, *trouble-free* performance.

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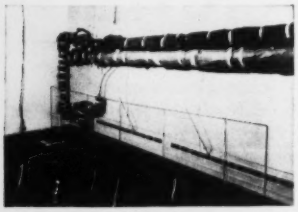
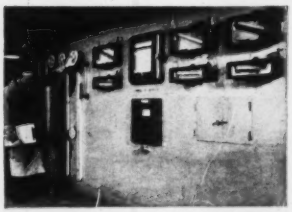
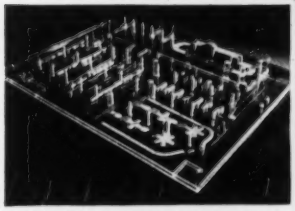
*Engineering staff ... assure full knowledge ... ments and practices.*



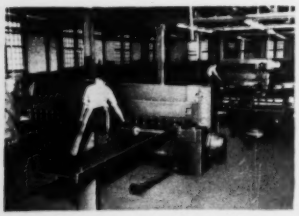
*Laboratory tests determine performance and assure accurate dependable capacity ratings.*



*Control board used for establishing desired operating conditions in accordance with recognized codes.*

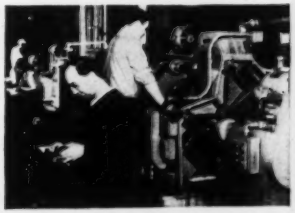


*Scale model of departmental layouts make it possible to locate machines and conveyors for economical production.*



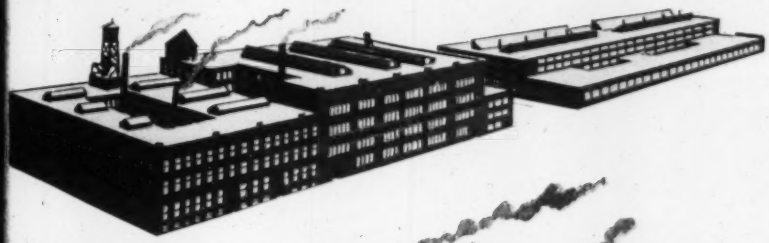
*Latest type power shears speed up cutting of sheet steel used in the manufacture of Fedders products.*

*View of one bay of a press room where sheet steel is formed into Fedders heating equipment.*

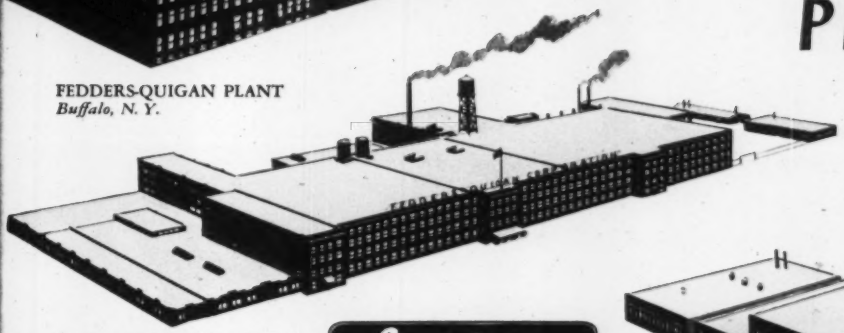


*High production machines completely finish castings for Fedders Convector Radiators in one trip through the machine.*

# MAKES HEATING EQUIPMENT IN 4 PLANTS



FEDDERS-QUIGAN PLANT
*Buffalo, N. Y.*



FEDDERS-QUIGAN PLANT
*Newark, N. J.*

fedders
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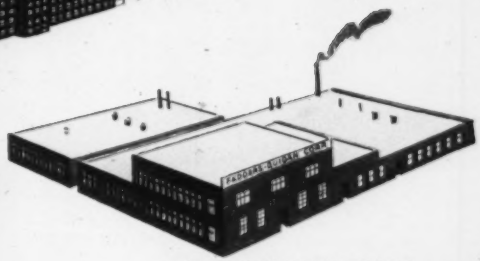
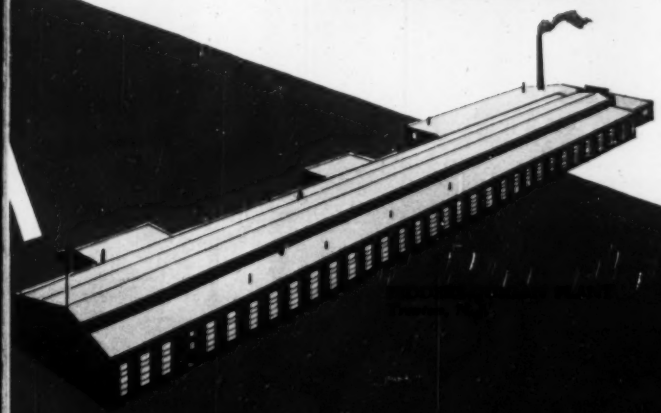


FEDDERS-QUIGAN PLANT
*Maspeth, N. Y.*



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They are built on a foundation of q ity products, satisfactory perform and volume sales.

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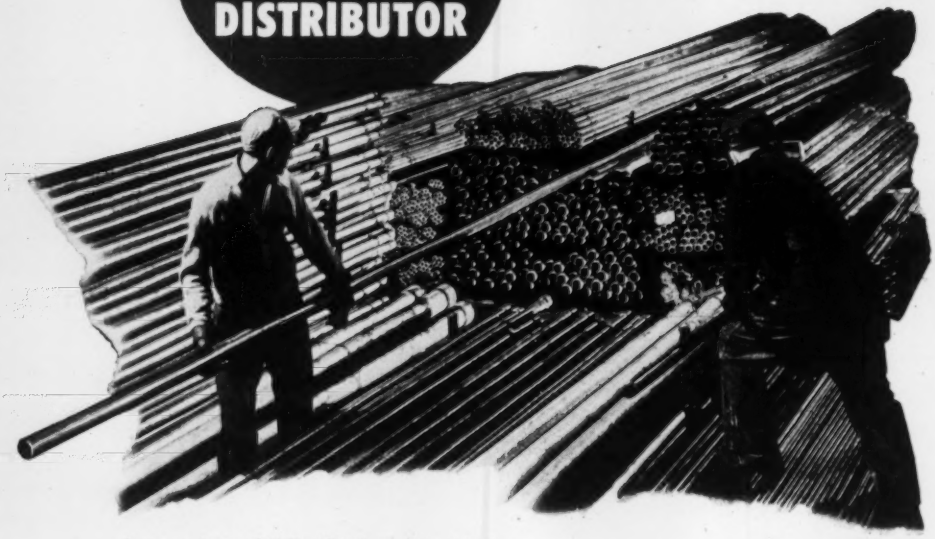

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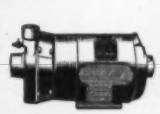
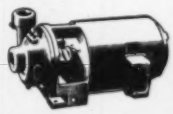
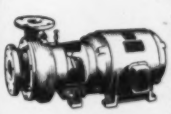


SSR Fractional hp.



Electrifugal 1 to 10 hp.



SSU 10 to 125 hp.

**ALLIS-CHALMERS PACKAGE PUMPS**

# NEW Electrifugal Pump

## ENDS SOME MAINTENANCE JOBS, SIMPLIFIES OTHERS TO CUT PUMPING COSTS!

NO OTHER CLOSE-COUPLED PUMP can offer you *all* of these money-saving advantages you get from an *Electrifugal* pump:

1. New sealed motor bearings eliminate usual bearing maintenance costs. Cannot be over or under lubricated.
2. New unit-cast iron frame has no adapter between pump and motor; provides great rigidity and broad, stable base.
3. New improved double seal on front motor bearing keeps liquid out of bearing under all normal operating conditions.
4. New streamlined design has smooth, easy-to-clean exterior, better appearance.
5. Large opening in frame between pump and motor makes packing maintenance quick and easy.
6. Pump and motor are designed, assembled and tested as a unit in the same plant to work together and cut your cost.
7. Nation-wide application engineering and service help you select the right pump for your job and keep operating costs low.

Other pumps in the Allis-Chalmers package pump line feature these same money-saving designs. Get all the facts from your Allis-Chalmers Authorized Dealer or Sales Office. Or write for Bulletin 52B6140. A-3061

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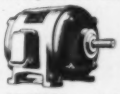

**MOTORS** — ½ to 25,000 hp and up. All types.

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**TEXROPE** — Belts in all sizes and sections, standard and Vari-Pitch sheaves, speed changers.

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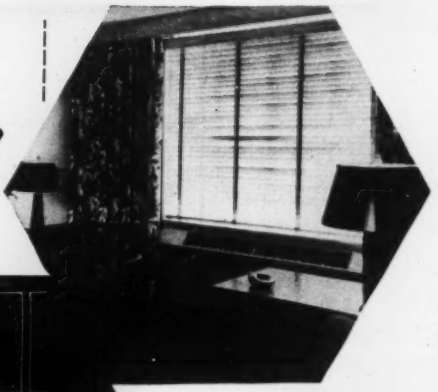
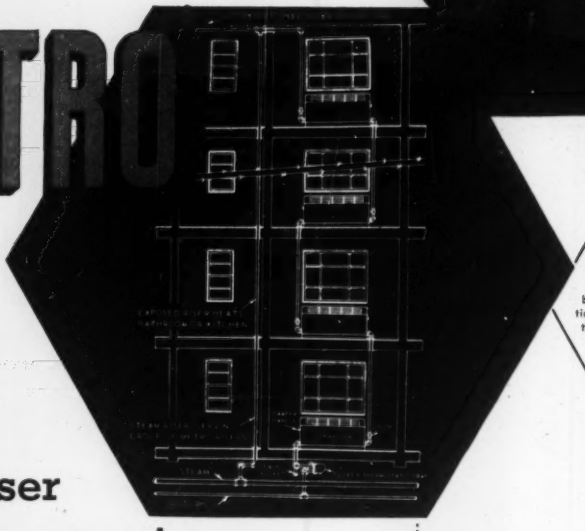
**ALLIS-CHALMERS**

# Startling!!... Revolutionary!

# 'METRO'



*Living room in Fresh Meadows Housing Project, showing "Metro" convector. "Metro" piping is concealed behind draperies.*



Single-riser provides an uninterrupted path for flow of steam from top to bottom of building. A continuous pipe passes down through overlying rooms... is offset in each room into a convector or baseboard.

## the single-riser heating system!

- **Eliminates traps and valves in occupied quarters. Only trap is at bottom of riser in basement.**
- **Eliminates all radiator branches.**
- **Eliminates furring of walls.**
- **Permits pre-cutting risers, all one size, in shop.**
- **Benefits contractors, owners and tenants.**

Economical to install, operate and maintain . . . "Metro" piping with Vari-Vac* control is the proved heating system selected for large-scale housing projects financed by The Metropolitan, Equitable, and New York Life Insurance Companies.

"Metro" keeps fuel bills at a minimum. Heat supply and demand are always in perfect balance because steam temperature is automatically regulated according to outside weather. In addition, damper controls permit individual room heat regulation.

**Dunham Vari-Vac Heating . . . the system that makes "Metro" possible . . . cuts fuel costs up to 40%**—A Dunham Vari-Vac Differential Heating System is adaptable to any size structure . . . old construction as well as new. A Dunham Sales Engineer can quickly tell which of seven different size Vari-Vac systems you'll want to install.

***SEND FOR FREE BULLETIN***

Write today for your free copy of Bulletin 643, giving complete information about economical "Metro" piping. C. A. Dunham Co., 400 W. Madison St., Chicago 6, Ill. *In Canada:* C. A. Dunham Co. Ltd., Toronto. *In England:* C. A. Dunham Co., Ltd., London.

**Variable Vacuum*

**CONVECTOR RADIATION, BASEBOARD RADIATION**

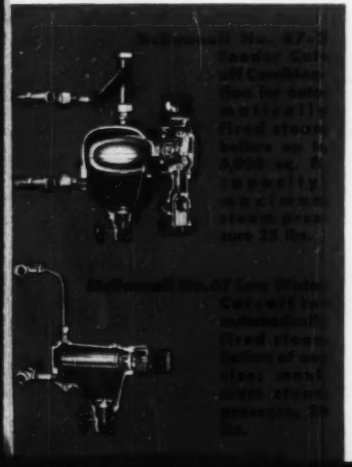
**UNIT HEATERS**

**DUNHAM**

**TRAPS, VALVES, PUMPS**

HEATING MEANS BETTER HEATING

# WE MOVED! . . . ON JUNE 10



After 25 busy years in Chicago's friendly Wrigley Building you can bet it was tough to pull up stakes and break up the old ties.

In this case, however, the blow of parting was lightened by the joy of moving into our own home — our new office building just completed alongside our modern plant at 3500 North Spaulding Ave. in Chicago.

This, as the home planners say, is our dream house; every detail of it planned and re-planned to fit every requirement of our general office operations.

We have never conceded anything to anyone in the matter of office operation and despatch . . . *but* . . . now we modestly say: "You aint seen nuthin, yet!"

Make us live up to this by sending your next problem (or order) to our

***New address of both general offices and plant:***

**McDONNELL & MILLER, INC.**

**3500 N. SPAULDING AVE. • CHICAGO 18, ILLINOIS**

Telephone COrnelia 7-1600

*Doing One Thing Well*

## McDONNELL *Boiler Water Level Controls*

YOU CAN BE **SURE**.. IF IT'S

Westinghouse

**FOR AIR HANDLING**

# No dripping grease

## ...at *ANY* angle

Many fans and blowers, and considerable air-conditioning equipment must be installed overhead, high above the floor. Dripping grease can be a nuisance. And motors high up mean motors "hard-to-get-at". Lubrication is a problem, also.

That's where Life-Line motors offer an easy solution. Life-Line motors need no lubrication . . . are equipped with sealed bearings, pre-lubricated with a more-than-ample supply of specially treated lubricant.

To you, this means: mount Life-Lines vertically, horizontally, or any angle "in-between". Correct lubrication is positive. Grease is sealed in . . . can't drip.

Too, Life-Line is ⅓ smaller than conventional-type motors—a valuable asset when design allows limited space. Check other Life-Line advantages with your nearby Westinghouse representative. Ask him for a copy of the Life-Line booklet, B-3842 or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-21560

—*If you figure LIFE-COSTS . . . you'll figure LIFE-LINE*—

Westinghouse *Life-Line* Motors

WESTINGHOUSE

*Serving*

**THE PACE-SETTERS OF INDUSTRY**

OIC

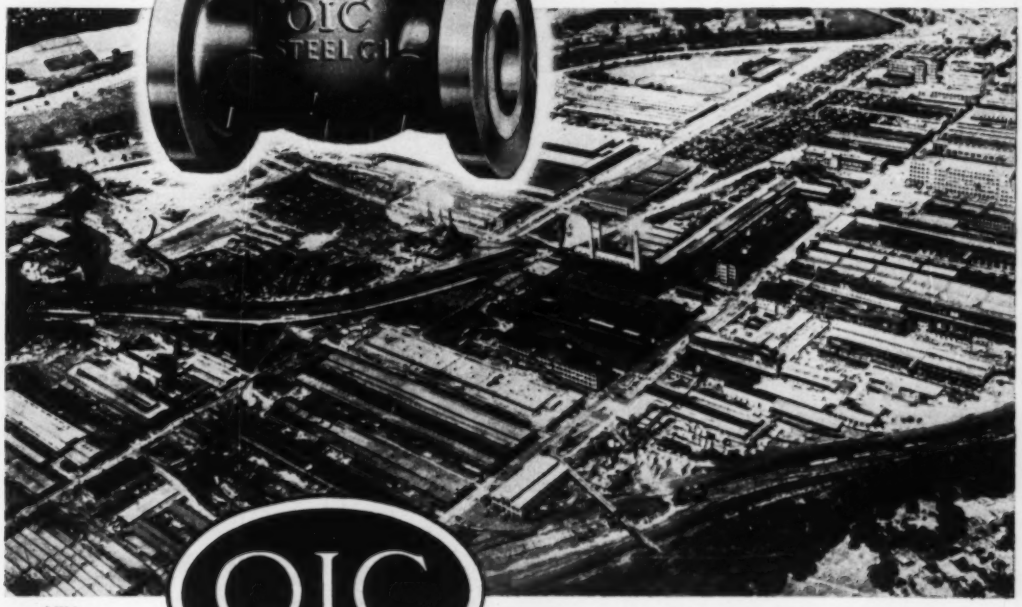
**SETS THE PACE IN VALVES**

GENERAL ELECTRIC uses OIC valves on many of the intricate processing operations at its huge Schenectady Works, shown below. The heavy construction of OIC gate, globe, angle and check valves provides plenty of safety margin for every industrial installation. See for yourself why so many of the leaders of industry are turning to OIC for reliable solutions to their valve problems. Contact your OIC distributor. Write direct to OIC for your copy of the new 1950

**VALVE CROSS REFERENCE CHART**

You can make your trial applications of the pace-setting line with the help of this handy chart. It offers you information on the *right* OIC figures to replace valves now installed in your plant.

THE OHIO INJECTOR COMPANY
243 Main St. Wadsworth, Ohio



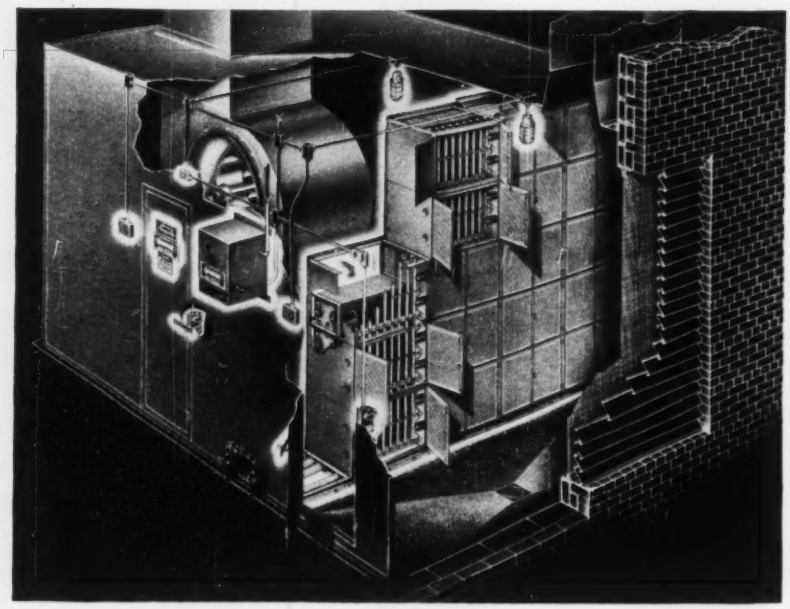
0-350-5

OIC **VALVES**

**FORGED STEEL • CAST STEEL • IRON • BRONZE**

# NO MECHANICAL AIR CLEANER CAN MATCH

# *Precipitron*®



## YOU CAN BE SURE...IF

J-E0186

# THE ELECTRONIC AIR CLEANER

When you buy an air filter, you are buying its *cleaning ability*. So consider this—while the best mechanical filters remove up to 30% of airborne dirt by volume, Westinghouse PRECIPITRON electronically removes 90% of *all* particles—even microscopic particles.

If airborne dirt is an obstacle in your manufacturing process, causes soilage, creates a hygienic problem or increases housekeeping costs, you need PRECIPITRON! This electronic cleaner will remove particles you can't see—as tiny as 1/250,000 of an inch.

PRECIPITRON, with its all-aluminum individual cell construction, offers you money-saving advantages. Greater plate area per cell enables you to clean any given volume of air at lower cost with less space and equipment. High resistance to rust and corrosion cuts maintenance, and its light weight means easy installation.

In terms of an air cleaner for your application, PRECIPITRON is unmatched. For complete information, write to Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Mass.

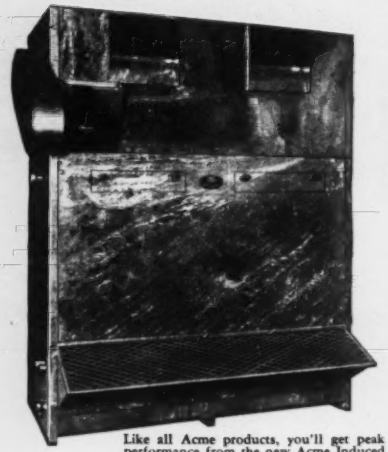
# IT'S Westinghouse

# YOU GET . . .

# 5 Plus Values

ACME PRODUCTS

## WITH ACME COOLING TOWERS



Like all Acme products, you'll get peak performance from the new Acme Induced Draft Cooling Tower. Count on Acme, to work with you on your next job.

### INDUCED DRAFT

New Acme Induced Draft Cooling Towers meet the exacting demands placed upon production units through closer control as processed refinements have developed in industry. In the induced draft tower the fan is mounted on top of the structure and air is pulled upward and discharged. Therefore, the new Acme tower is not subjected to the recirculation of hot humid exhaust vapor back into the air intake, and is independent of variable wind velocity and direction. Increased efficient performance is the result achieved.

### QUIET OPERATION

Operation is quiet since squirrel cage fans are used instead of propellor type and exit air velocities are maintained at a low level.

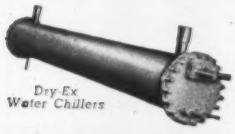
**WATER SAVING**— Spray nozzles are non-clogging and break up the water into fine drops and not into an atomized spray. As the water is used over and over, little is wasted. This is an important factor today in localities where water supply is scarce and costs high.

**LONG LIFE DESIGN**— You'll find many improvements and refinements in Acme's new cooling tower. For example the cooling pads are especially treated and NON-CORROSIVE. Housing is constructed of 11 and 14 gauge steel, hot dipped galvanized AFTER FABRICATION. Self-aligning bearings are equipped with Acme's exclusive vented supports and designed to prevent grease migration. Attention too, has been paid to details for servicing, and parts are easily accessible. Base section is equipped with a removable splash trough and intake screen for easy access to float valve assembly.

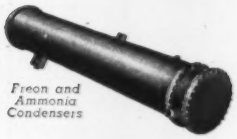
**PERFORMANCE AND CAPACITY**— Acme cooling towers are recommended for applications which require water conservation and the dissipation of heat from cooling water, whether it be for comfort cooling, industrial or commercial use. Available in capacities from 3 to 40 tons, economical to install, operate and service.

*Write for Acme Cooling Tower Bulletin 40-A*

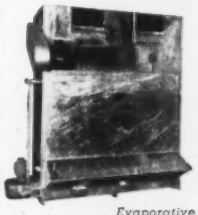
Oil Separators



Dry-Ex Water Chillers



Freon and Ammonia Condensers

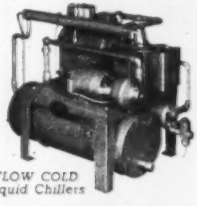


Evaporative Condensers

Shell and Coil Condensers

Liquid Receivers

Heat Exchangers



FLOW COLD Liquid Chillers

REPRESENTATIVES IN PRINCIPAL CITIES

# ACME INDUSTRIES INC.

JACKSON, MICHIGAN

Serving The Refrigeration Industry Since 1919

# Profitable way to purchase piping ... Get everything from CRANE

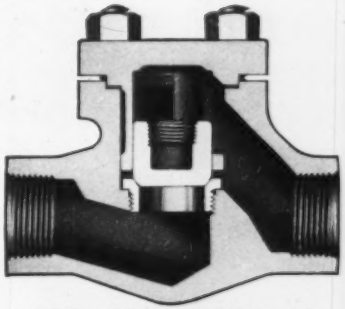
### SMALL STEEL LIFT CHECKS WITH BETTER FLOW

Looking for small steel lift checks that don't chatter, and have extremely low pressure drop? Then specify these Crane 600-Pound Forged Steel Lift Checks. They have a patented cap-sleeve construction that provides high disc lift, even at low velocities, thereby eliminating destructive pounding and chattering. Special design of body contours and port openings give unusually low pressure drop.

Seats and discs are of wear-resisting Crane Exelloy. Rugged, forged steel bodies will withstand severe, high pressure services.

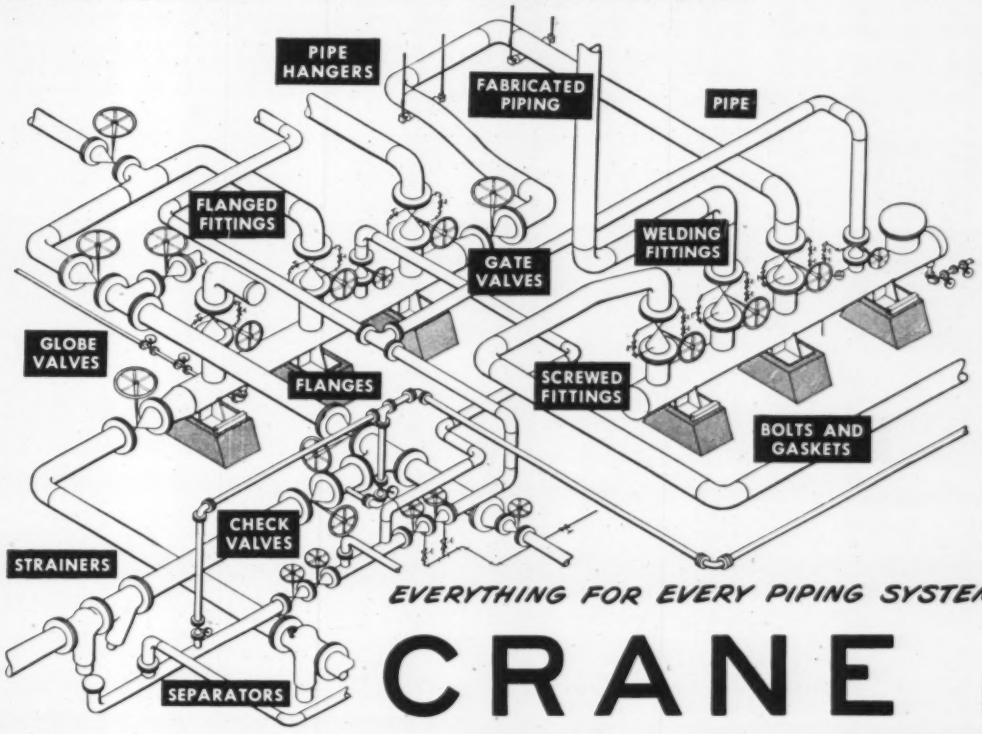
You can get these checks with union caps, screwed or socket welding ends, sizes ¼ through ¾ inches. Or with bolted cap, screwed, socket welding, or flanged ends, in sizes ½ through 2 inches. See your No. 49 Crane Catalog, pages 248-249.

CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.
*Branches and Wholesalers Serving All Industrial Areas*



**600-Pound Forged Steel Horizontal Check with Bolted Cap. For steam, water, air, and gas up to 850° F.; for oil or oil vapor up to 1000° F. Sizes: ½ to 2-in. Screwed, flanged, or welding ends.**

## ● THIS HIGH PRESSURE STEAM SYSTEM CAN BE 100% CRANE-EQUIPPED ... THROUGH ONE PURCHASE ORDER

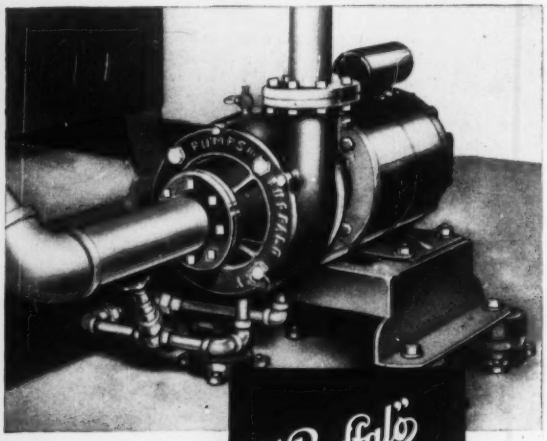



*EVERYTHING FOR EVERY PIPING SYSTEM*

# CRANE

*VALVES • FITTINGS • PIPE • PLUMBING AND HEATING*

"Buffalo" Class "RR" Pump for Boiler Feed and Other Clear Water Service.



"Buffalo" No. 1½ CCS Close-Coupled Pump Circulating Water for Air Conditioning.

"Buffalo"
CENTRIFUGAL PUMPS FOR EVERY SERVICE

# ECONOMY

## THE INEVITABLE RESULT OF TROUBLE-FREE "Buffalo" PUMP PERFORMANCE

● Ask anyone who has used pumps a good long while—he'll say the ECONOMICAL pump is the one you can practically ignore! It not only saves on repair bills, but on expensive timeouts where plant functions depend on pumping.

● If you want this major economy, specify "Buffalo" for your next pumping job. "Buffalo" construction—impellers, bearing stands, shafts, casings and stuffing boxes — makes no compromise with quality. Add to this the economy of high-efficiency performance—and the inevitable result of owning a "Buffalo" Pump is economy that adds up through the years. Call in your "Buffalo" engineering representative, or write us for complete information.

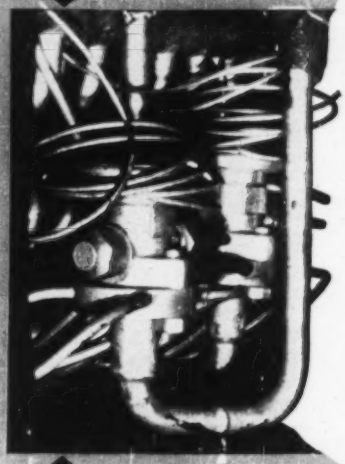
## BUFFALO PUMPS INC.

171 Mortimer St. Buffalo, N. Y.

Canada Pumps, Ltd., Kitchener, Ont.

Branch Offices in all Principal Cities

# THIS COIL



# CAN'T "LOAF"

— because this ALCO MULTI-OUTLET THERMO VALVE feeds *all* circuits equally regardless of load changes

You're *sure* of full coil capacity — maximum evaporator efficiency — when you specify ALCO Multi-Outlet Thermo Valves. Here's why:

Refrigerant is accurately metered at point of expansion *within* valve body

No separation of gas and liquid before distribution — no flooding or short-circuiting

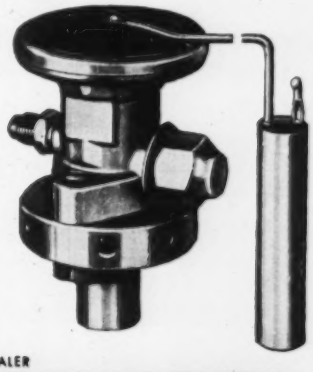
Higher operating suction pressure — accurate control — no hunting or cycling

Minimum moving parts mean less friction, quicker response — simple "come-apart" construction for easy servicing without removing from line

INCREASE COIL CAPACITY UP TO ⅓ — specify

## ALCO MULTI-OUTLET THERMO VALVES

2 to 36 outlets — ½ to 50 tons F-12



25 YEARS

SEE YOUR ALCO WHOLESALER

## ALCO VALVE CO.

861 KINGSLAND AVE. • ST. LOUIS 5, MO.

A QUARTER-CENTURY OF PIONEERING AND PROGRESS

Designers and Manufacturers of Thermostatic Expansion Valves; Evaporator Pressure Regulators; Solenoid Valves; Float Valves; Float Switches.

4400

# Tight Seams easy with U·S·S Galvanized Sheets

When you use U·S·S Galvanized Steel Sheets, you get true bends, tight seams, and neat joints even in forming the most difficult shapes. Backed by research, engineering and production facilities second to none, they are famous for their forming characteristics.

You can bank on the uniformity of these superior sheets. The fact that they are closely controlled in size, weight, ductility, flatness and finish makes for more accurate and faster work.

That's why it pays to get sheets bearing the familiar U·S·S Trade-Mark. Not only will they pay dividends in their greater workability, but they will enhance the value and increase the salability of the jobs and products you turn out.

To stand up under severe atmospheric conditions

**U·S·S GALVANIZED COPPER STEEL SHEETS**

*— give twice the atmospheric corrosion resistance at little additional cost!*

CARNEGIE-ILLINOIS STEEL CORPORATION, PITTSBURGH
COLUMBIA STEEL COMPANY, SAN FRANCISCO
TENNESSEE COAL, IRON & RAILROAD COMPANY, BIRMINGHAM
UNITED STATES STEEL SUPPLY COMPANY, WAREHOUSE DISTRIBUTORS, COAST-TO-COAST
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS **GALVANIZED STEEL SHEETS**

UNITED STATES STEEL

# LEADER IN ITS FIELD

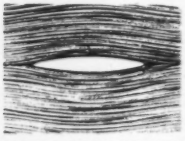
**Outperforms** **Costs Less** **Installs Easier**

Shown above is the Airfoil Model No. 270. Features 2 sets of Airfoil louvers plus the *special design concealed support.*

**Adds Beauty**

# Air Foil

## AIR CONDITIONING OUTLETS



Illustrated above — Streamlined Airfoil louver knifes the air in wind tunnel tests. Note how turbulence has been almost completely eliminated.

Airfoil Grilles feature the ***FIRST REALLY NEW IDEA*** in air conditioning outlet design —the streamlined, smooth-as-glass ***Airfoil Louver.*** This louver—adapted from the aerodynamically perfect airfoil section of an airplane—makes possible matchless air diffusion and distribution. Airfoil Grilles handle higher air velocities with minimum turbulence, minimum noise and perfect draft-free performance. Blades are individually adjustable—made in solid sections of extruded material.

Enthusiastic contractors, architects and engineers—Nation-wide—declare these ***new Titus Airfoil Grilles outmode all others.***

***Their design handles air diffusion and distribution like no other grille ever has.***

## THE *Airfoil* LINE IS COMPLETE

- Air Conditioning Outlets
- Return Air Grilles
- Return Air Registers
- Volume Controllers
- Ceiling Outlets
- Perforated Metal Grilles
- Ornamental Grilles
- Door Ventilators
- Marine Diffusers
- Industrial Air Distributors
- Floor Registers
- Automatic Back Pressure Dampers
- Grilles for Room Air Conditioners
- Special Made-to-Order Grilles
- Installation Frames and Accessories
- High Velocity Factory Outlets
- Toilet Exhaust Registers
- Plain Lattice Grilles
- Grilles for Convector Radiators

**AUTHORIZED REPRESENTATIVES IN ALL PRINCIPAL CITIES**

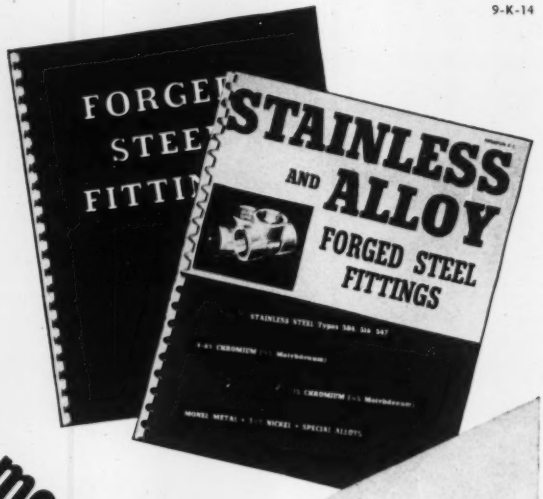
**TITUS MANUFACTURING CORP.**
**WATERLOO, IOWA**

**Gentlemen: Please rush me complete information including prices, discounts and delivery on the complete Airfoil line.**

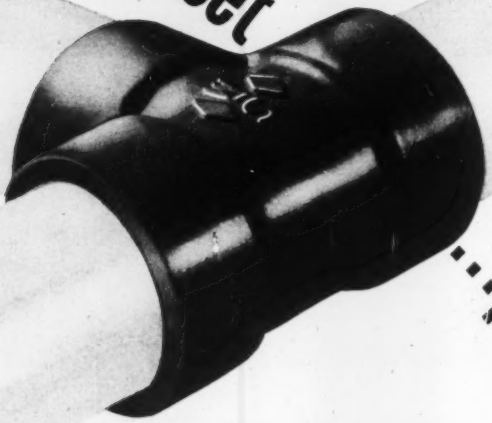
NAME.....

ADDRESS.....

CITY..... STATE.....




# Wherever pipes meet ...permanently



## IN THE REFRIGERATION FIELD,

the surest and safest way to prevent fittings leaks is to install W-S Double-diamond Screw End and Socket Weld Forged Steel Fittings.

Designs are carefully engineered. Basic Materials are selected from a wide choice of carbon, stainless and alloy steels. Drop forging and precision machining makes them light in weight, assures accuracy of finish, and, all are instrument inspected for perfection of threads, sockets, angles and concentricity. Investigate them today.

Write for Bulletin A3-50. For information on stainless and alloy steel fittings ask for Bulletin S-1.

SOLD THROUGH LEADING DISTRIBUTORS EVERYWHERE

SPECIFY...

W-S

FORGED STEEL FITTINGS

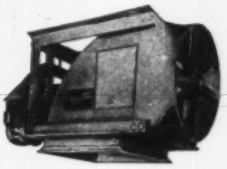
DISTRIBUTORS PRODUCTS DIVISION **WATSON-STILLMAN** ESTABLISHED 1848 • ROSELLE, NEW JERSEY

Designers and Manufacturers of Forged Steel Fittings, Valves, Wire Rope Shears, Hand Pumps, Jacks, Pipe Benders and Hydraulic Equipment

# WING VENTILATING EQUIPMENT

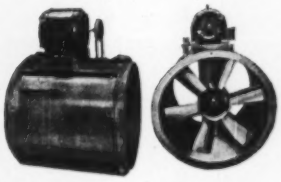
### WINGFOIL SAFETY VENTILATING FAN

Distinguished for efficiency and rugged construction. The new Wingfoil fan wheel moves maximum volumes of air with minimum horsepower, due largely to its non-overloading feature. Sizes from 10" to 60" dia., with free air capacities from 825 to 59,000 CFM. Larger sizes on special order. Either direct or belt drive. Heavy steel guards provide safety.



### WINGFOIL DUCT FAN
**(Elbow Type)**

Designed to form an elbow in the duct system, the elbow-shaped housing in a strong rectangular frame permits installation with the inlet in any desired position. Motor and drive are outside the air stream, therefore remain cool, clean, and easily accessible. The new Wingfoil Fan has a remarkable "non-overloading" characteristic. Sizes 10" to 60"; capacities up to 85,000 CFM.



### WINGFOIL DUCT FAN
**(Straight Line Type)**

Designed to form a part of any straight run of duct. The motor is mounted on an adjustable base outside of the housing. V-belt drive is through an air tube carried across the housing and supporting fan shaft and bearings. Fan wheel is the new non-overloading Wingfoil Fan. Bearings are grease-sealed, requiring minimum of attention.

*Write For Bulletins*

## Heated Air in Motion Keeps Metals From "Sweating"

AN exclusive advantage of WING Revolving Unit Heaters applies to rooms and buildings in which metal products are stored. In the above photograph, taken in the Jones & Laughlin plant at Muncy, Pa., the Wing Revolving Heaters keep the warm air in circulation among the coils of wire stored in this building, reaching every remote corner and preventing the "sweating" that would otherwise cost thousands of dollars in corroded metal. Even if *you* haven't this problem in *your* plant, this exclusive feature of the Wing Revolving Discharge keeps employees comfortable for the same reason. Write for Bulletin No. HR-5.

**L. J. Wing Mfg. Co.**

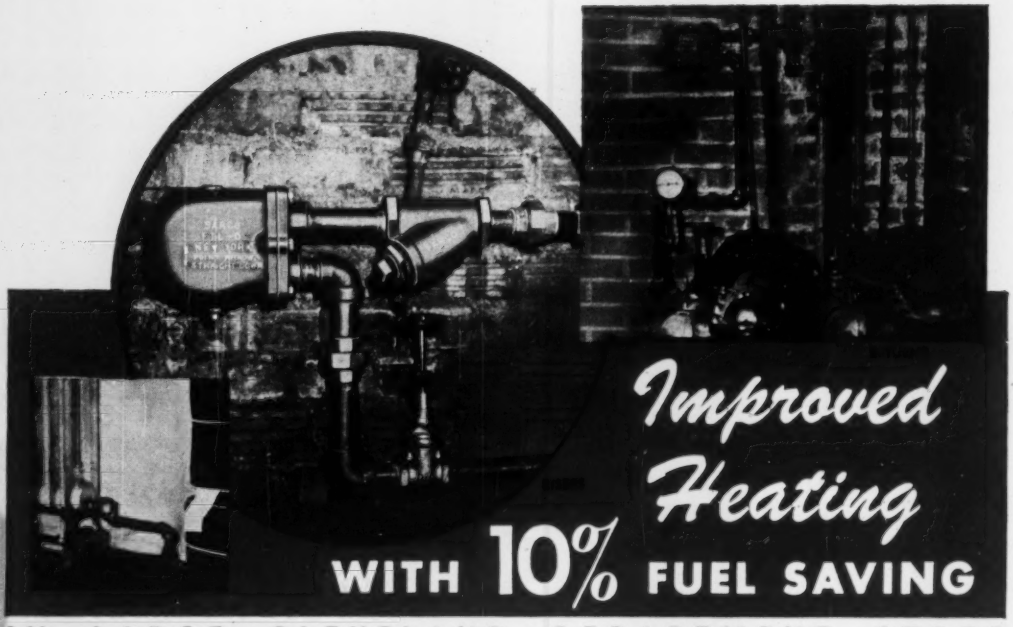
140 Vreeland Mills Road
Linden, N. J.

*Canadian Factory: Montreal*

WING

# Wing

## Revolving UNIT HEATERS



# *Improved Heating*

## WITH 10% FUEL SAVING

## IN LARGE CLEVELAND DEPARTMENT STORE

**And what happened here could happen in any kind of building or factory — anywhere!**

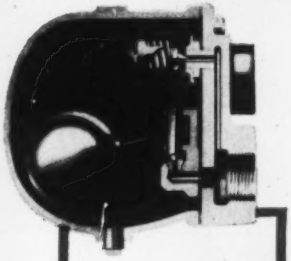
It all started with unhappy customers and clerks, who were always too hot or too cold, depending on what part of the store they were in at the time. Management was annoyed by steam knocks that seemed to be tearing the place down and the engineer lived in a cloud of steam generated at the point where the condensate entered the sewer.

Between the dollars lost in steam and the uncalculated dollars lost in trade stood the shivering occupants in a situation satisfactory to no one.

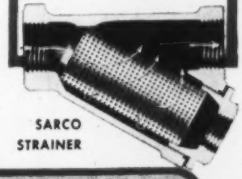
A phone call to the local heating contractor brought immediate results. Two types of Sarco thermostatic steam traps were installed wherever condensate could accumulate, the pipe lines were modified and the entire system protected with Sarco Strainers.

Now an ideal heating system uses 10% less metered steam than it did before and everybody is satisfied.

Unsatisfactory heating systems don't always make noise or produce clouds of steam, but a heating expert can tell you whether you are getting a dollar's worth of heat for every dollar you spend. The Sarco Representative in your vicinity will be glad to co-operate with your engineer.



**THIS IS THE SARCO STEAM TRAP** that is used by the thousands on heating systems.



SARCO STRAINER

177

**SARCO SAVES STEAM**

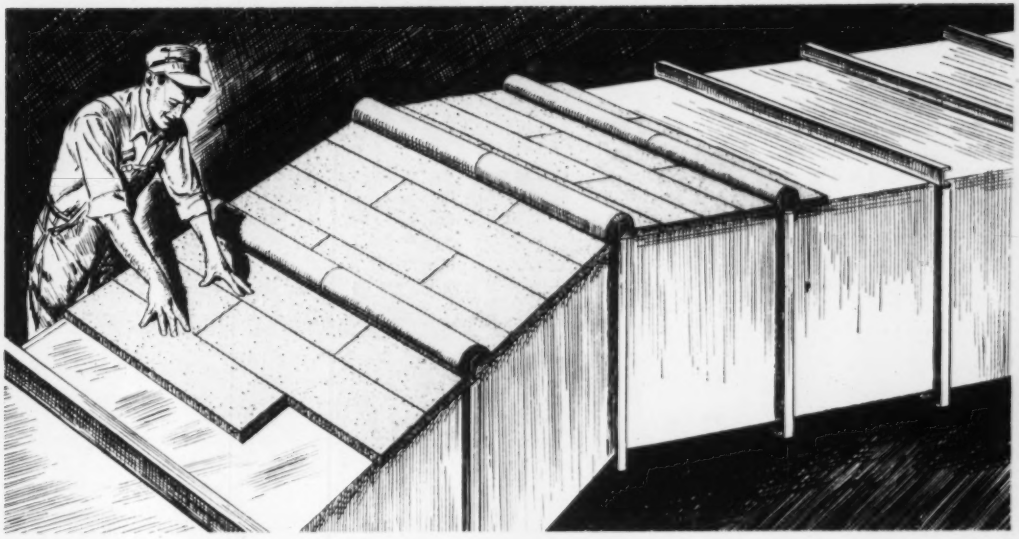
**SARCO COMPANY, INC.**

*Represented in Principal Cities*

Empire State Building, New York 1, N. Y.

SARCO CANADA, LTD., TORONTO 5, ONTARIO

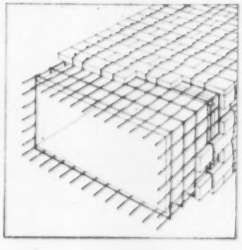
IMPROVES PRODUCT QUALITY AND OUTPUT



# What's wrong with this picture?

The block insulation on this outdoor high-temperature breeching is being applied directly to the metal surface between the channel-iron stiffeners. Each stiffener is then covered separately with a half section of pipe insulation. This method means extra work, and it doesn't allow any give in the insulation to take care of expansion and contraction of the breeching. As the breeching moves, cracks will appear in the finish, letting in the weather and reducing efficiency.

A better way to insulate a breeching like this is to weld 6″ x 6″ welded mesh over the stiffeners, then wire the insulation to the mesh. This eliminates the need to cover each stiffener separately. The mesh absorbs movement, allowing the duct to expand and contract without cracking the insulation finish.



There are breechings where it might be better to apply the insulation directly to the metal surface. The right method to use depends on placement and size of the stiffeners, expansion and contraction of the metal, and temperatures inside the breeching.

On almost any heat insulation job, choosing the right construction depends on careful analysis of every factor involved. Armstrong engineers can do this for you. These men are trained to come up with the correct answers to every insulation problem. Their advice can often make your job a better one and save you money as well.

In addition to engineering help, the complete contracting organization these men represent offers you both high-quality insulation materials and skilled workmen to apply them. Before you plan another heat insulation job, call the Armstrong office nearest you.

★ ★ ★

**SEND FOR FREE BOOKLET**

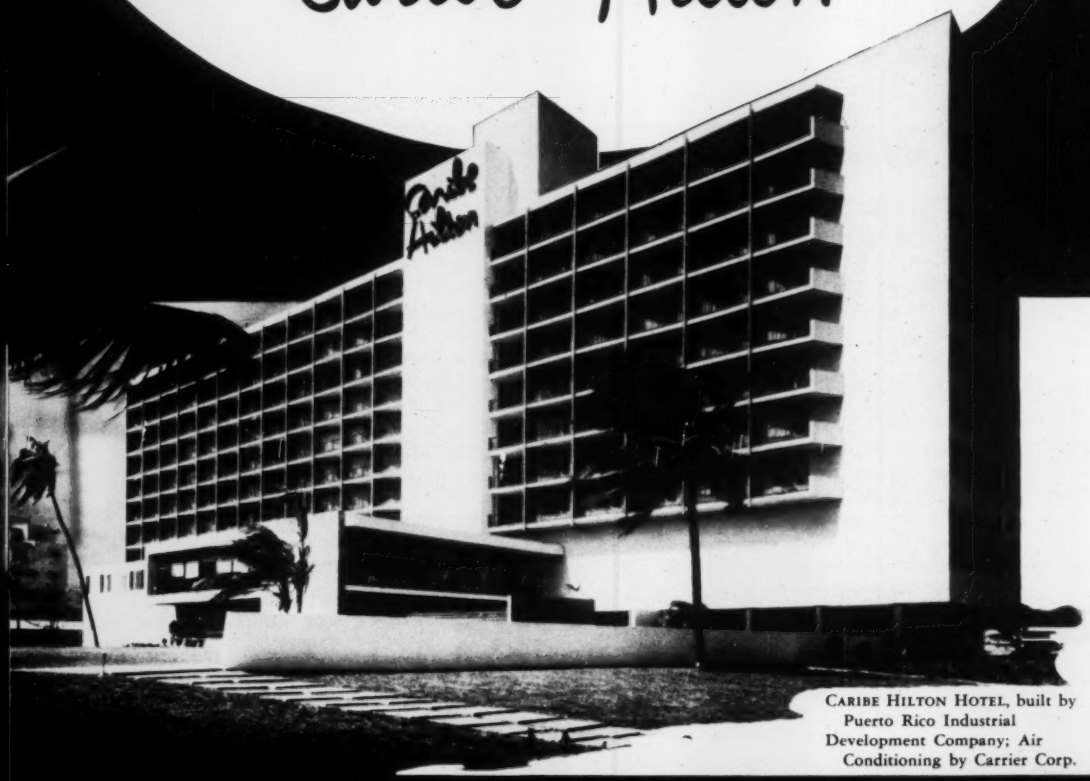
"People Make A Good Insulation Job" explains the operation of Armstrong's Contracting organization. We believe you'll find it interesting reading. Write for your copy to Armstrong Cork Company, Building Materials Division, 4407 Maple Avenue, Lancaster, Penna.

# ARMSTRONG'S INDUSTRIAL INSULATIONS

**MATERIALS - INSTALLATION**

**FOR ALL TEMPERATURES FROM 300°F. BELOW ZERO TO 2800°F.**

"Buffalo" FANS and PUMPS USED IN FAMOUS Caribe Hilton




CARIBE HILTON HOTEL, built by Puerto Rico Industrial Development Company; Air Conditioning by Carrier Corp.

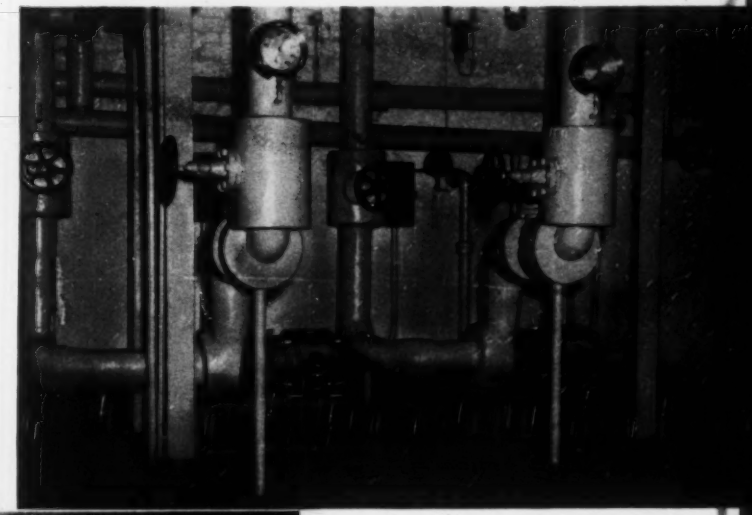
"Buffalo" FIRST FOR PUMPS and FANS

# SPECIFY THIS "BUFFALO" EQUIPMENT FOR BEST RESULTS IN *Your* BUILDING!

*Caribe Hilton,* ultra-modern ten-story hotel in San Juan, Puerto Rico, is the latest triumph of the Hilton group.

It is no coincidence that many of this hemisphere's leading public buildings and plants are served by "Buffalo" Fans and Pumps. Other users of "Buffalo" equipment are the Terrace Plaza and the Shamrock. The "Buffalo" reputation for long life and efficiency on the job goes back seventy-two years. Many "Buffalo" Ventilating Fans are still performing well after fifty or more years, while "Buffalo" Pumps are setting similar endurance records.

*Be sure of the air handling and liquid handling service in YOUR building plans—specify "Buffalo".*

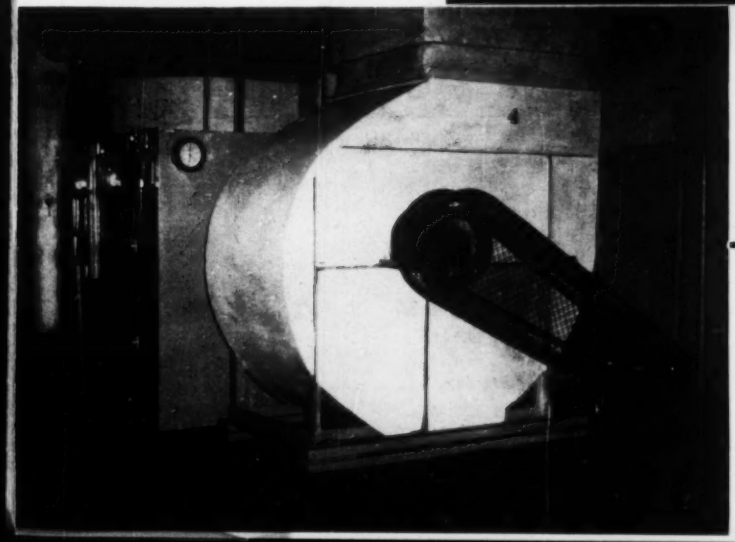


**BUFFALO FORGE COMPANY**

171 MORTIMER ST.
BUFFALO, NEW YORK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

Branch Offices in all Principal Cities

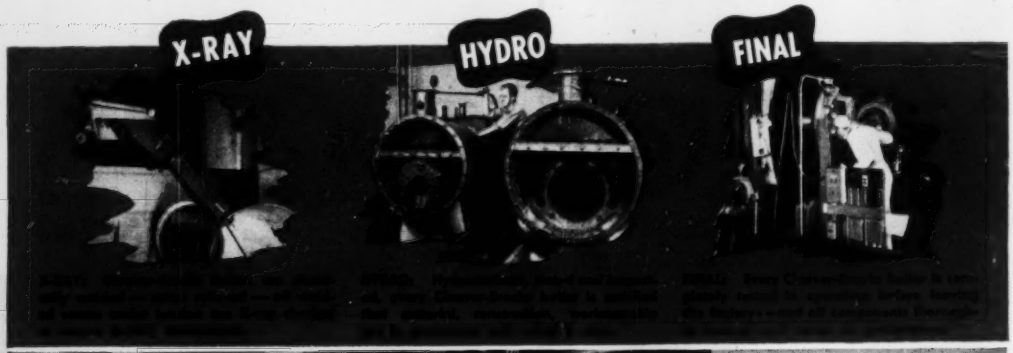


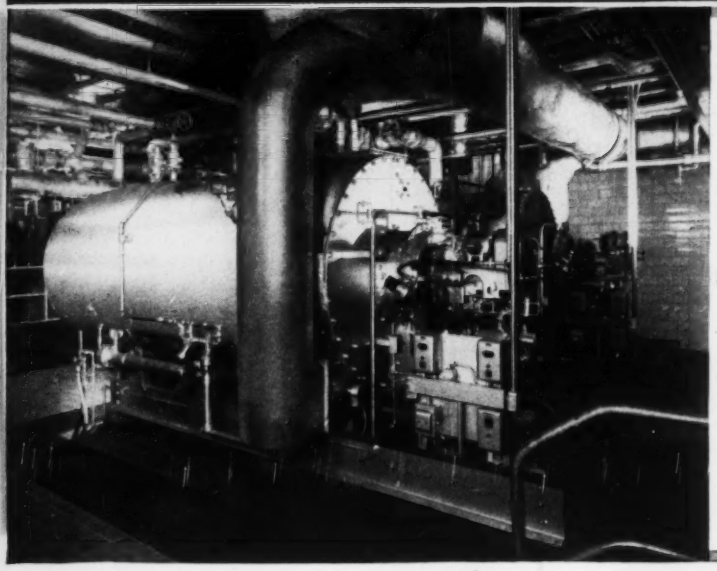
"BUFFALO" CLOSE-COUPLED PUMPS are widely used on air conditioning service.

"BUFFALO" LIMIT-LOAD FAN, popular for large-scale ventilation or air conditioning.

# FACTORY-TESTED AND JOB-TESTED

## . . . Another Reason Why You Get A Greater Return From Your Investment In A Cleaver-Brooks Steam Boiler



*Performance on Location:*

*Boilers are placed in operation by Cleaver-Brooks service representatives who check installation, operation and make a complete and detailed field report. Your operators are trained in care and operation by Cleaver-Brooks.*

Exact and detailed testing—progressively—at successive stages in manufacturing and assembly—operation tests under load at the factory — plus final operation test on location in your plant — these are standard Cleaver-Brooks procedures to assure you in advance of peak performance.

*Flexible Operation Burning Gas or Oil With Equal Efficiency:* You can use oil, gas, or combination oil and gas, whichever is of lower cost. Through high heat transfer, Cleaver-Brooks boilers operate at a guaranteed efficiency of 80% from full load down to 30% of rating.

In addition, Cleaver-Brooks boilers give you clean, smokeless operation—eliminate fuel—ash handling —require no high or costly stacks— no special foundations — fit under low headroom—provide quick steaming, flexible operation to meet fluctuating loads—fully meet all codes.

Available in sizes 15 to 500 H.P., 15 to 200 P.S.I. — write for new Cleaver-Brooks steam boiler catalog.

**CLEAVER-BROOKS COMPANY, 367 E. Keefe Ave., Milwaukee 12, Wis.**

# Cleaver-Brooks

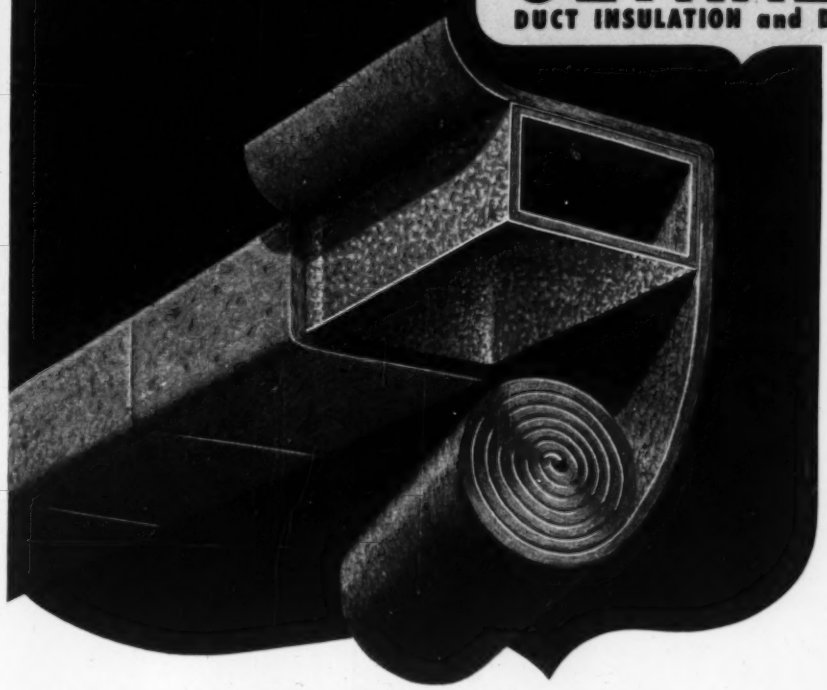
**STEAM BOILERS**

**NEW** — the Cleaver-Brooks Steam Boiler Catalog—interesting—informative—beautifully illustrated. Write—on your business letterhead—for your copy.

*Wrap your troubles in*

# ULTRALITE

**DUCT INSULATION and DUCT LINER**



## *and deliver better jobs . . . faster . . . cheaper!*

Just *once,* try Ultralite, the long glass fiber insulation—and you'll never use any other insulation! For Ultralite goes on *faster, easier, cheaper* . . . and it does a better job of deadening sound and keeping heat and cold where they belong.

No need to handle Ultralite with kid gloves, for it's tough, resilient — won't break, flake, chip or dent. You can cut it readily with a knife, wrap ducts as you would a package. You can run it quickly around curves and corners. You can fasten it in place with wires or metal screws and washers or cement. And Gustin-Bacon offers *six different vapor barrier facings,* one of which is tailor-made for your particular condensation problem.

The superior thermal and acoustical properties of Ultralite in various thicknesses and densities are readily apparent from the charts in A.I.A. file No. 37-D-2. You'll like, too, the physical properties of Ultralite. The long glass fibers are fire-resistant, non-corrosive, non-irritating and as permanent as glass itself. Ultralite will not settle, shake loose, delaminate or disintegrate under air movement or vibration, nor will it pick up odors. Try Ultralite in your shop . . . soon!

**For free samples and A.I.A. file No. 37-D-2, WRITE TODAY!**

Please send me samples of Ultralite and A.I.A. file 37-D-2.

NAME_____

COMPANY_____

ADDRESS_____

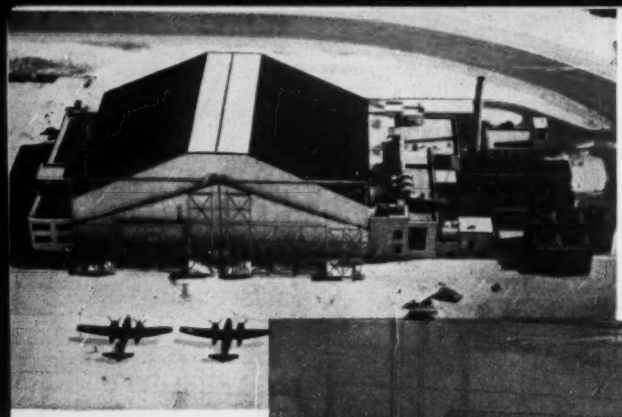
CITY_____ STATE_____

GUSTIN-BACON MANUFACTURING CO. ULTRALITE

**GUSTIN-BACON MFG. CO.**

1412 WEST 12TH ST., KANSAS CITY, MO.

New York Chicago Philadelphia San Francisco Los Angeles
Houston Tulsa Ft. Worth



# Whether the COLD WAR Simmers or Sizzles

WORLD'S LARGEST CLIMATIC TEST LABORATORY

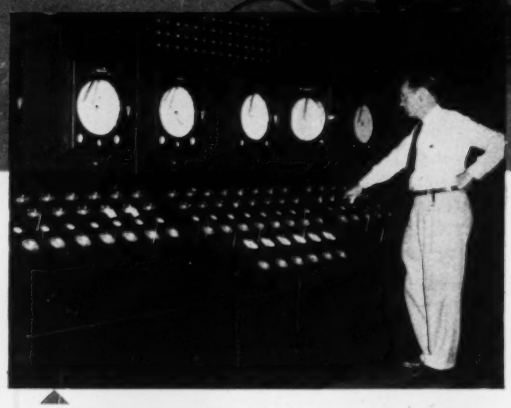
Above
**CLIMATIC HANGAR**
Air Proving Ground
Headquarters
**EGLIN AIR FORCE BASE**
**FLORIDA**

Architects and Engineers
ROBERT & COMPANY
ASSOCIATES, Atlanta

General Contractors
J. A. JONES
CONSTRUCTION CO.
Charlotte, N. C.

Air Conditioning by
YORK CORP.

SIZE OF HANGAR
200' x 250' x 70'

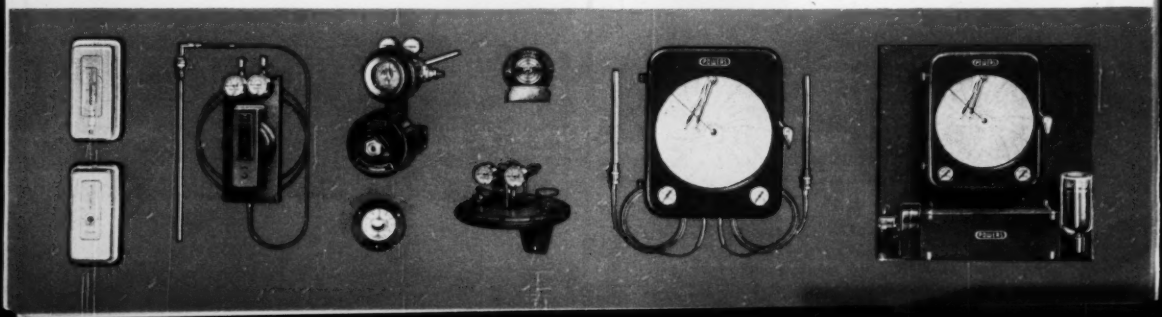


**WEATHER CONTROL PANEL**—POWERS Series 100 Recording Regulating Instruments, and pneumatic switches for remotely controlling air conditions in Climatic Hangar shown above.

POWERS

Pneumatic Control Systems also used in—

ARMY SIGNAL CORPS CLIMATIC LABORATORY
Ft. Monmouth, New Jersey
N. A. C. A. Aircraft Engine Research Laboratory, Cleveland, Ohio
and many other prominent test laboratories



# POWERS Control Helps EGLIN Climatic Hangar Keep Cool

### *at 165°F. down to 65°F. Below Zero*

### *Air Force Equipment Is Tested In All Kinds of Weather*

Here at Eglin Air Force Base, Florida, "cold war" is waged against defective combat and ground equipment. In the giant hangar B-36's and smaller planes, tanks, housing and vehicles are tested in man made arctic blizzards, tropical hurricanes, jungle dampness or dry desert heat. Jet engines, weapons, men, food, clothing and photographic equipment are tested in smaller rooms.

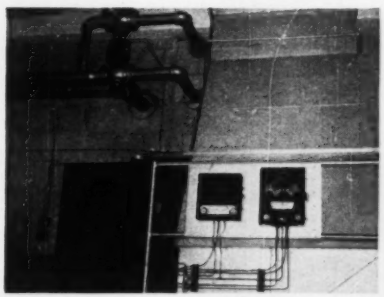
Air conditioning control problems encountered here, presented an interesting challenge for POWERS engineers. Many years of experience gained in meeting the unusual demands of other prominent military, industrial, public and commercial buildings were helpful in providing the automatic controls required for this "World's Largest Ice Box"

We welcome an opportunity of helping you find the right solution to your problems of air conditioning control. Whether they be simple, complex, large or small you can benefit from our many years of valuable experience. Phone or write your nearest POWERS office.

**THE POWERS REGULATOR COMPANY**

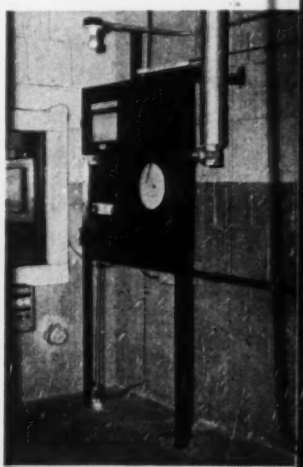
***Established 1891. Offices in Over 50 Cities, see your phone book***

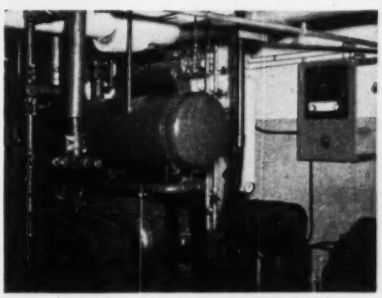
Chicago 14, Ill., 2759 Greenview Avenue • New York 17, N. Y., 231 E. 46th Street
Los Angeles 5, Calif., 1808 W. 8th Street • Toronto, Ont., 195 Spadina Avenue

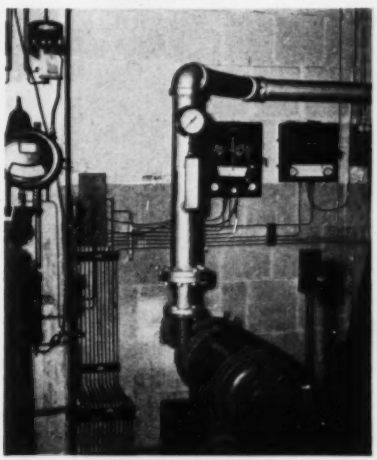


POWERS

Controlling, Indicating and Recording Instruments Regulating Air Conditioning in Smaller Test Rooms.



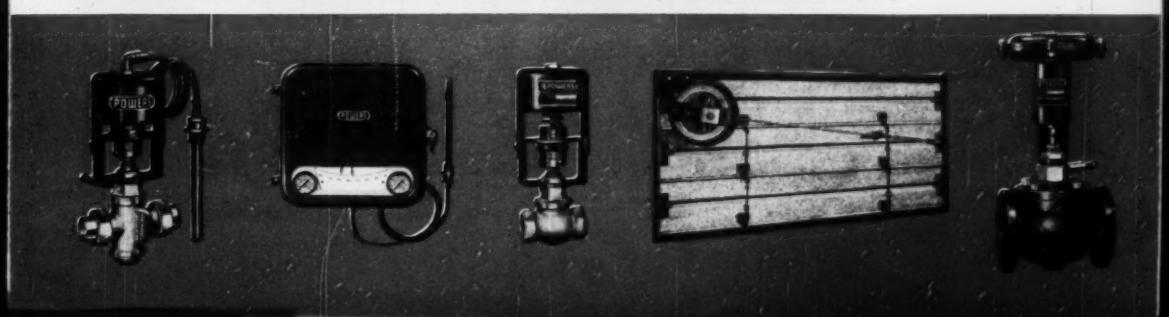




**WHEN YOU WANT ACCURATE AIR CONDITIONING CONTROL**

Call in a Powers Engineer. He may be able to help you get the best control for your requirements.

(ACEF)



# Zallea Expansion Joint News

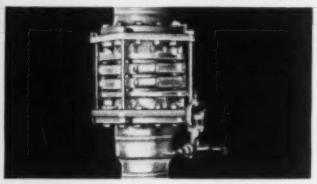
PUBLISHED BY ZALLEA BROTHERS—WORLD'S LARGEST MANUFACTURERS OF EXPANSION JOINTS EXCLUSIVELY

**Expansion Joint of the Month**

## Why Zallea Joints Last Longer

### ANOTHER ZALLEA REPEAT

When West Penn Power Company added No. 7 Unit to its Springdale, Pa. Station in 1945, Zallea Stainless Steel Expansion Joints were installed to provide for expansion of the piping. Three years later, West Penn *again* selected Zallea Joints for use in its new Mitchell Station at Courtney, Pa. And, a second unit at Mitchell, recently constructed, is *also* equipped with Zallea Stainless Steel Expansion Joints. Here, as in hundreds of cases, satisfied repeat customers continue to specify Zallea when they want



the utmost in economy, dependability and long service life. *There's no packing to deteriorate . . . no maintenance required.* There's a Zallea Expansion Joint for almost every requirement. Available in diameters from 3" to 72" for temperatures from sub-zero to 1600° F. . . . for pressures from vacuum to 300 psi in standard designs and up to 2000 psi in special designs.

. . . a complete, practical catalog on all Zallea Expansion Joints. A text book and a valuable reference source. Send for your *free* copy *today!*

ZALLEA BROTHERS, 816 Locust Street, Wilmington 99, Delaware

### Longer Service Life Assured Through Controlled Manufacture

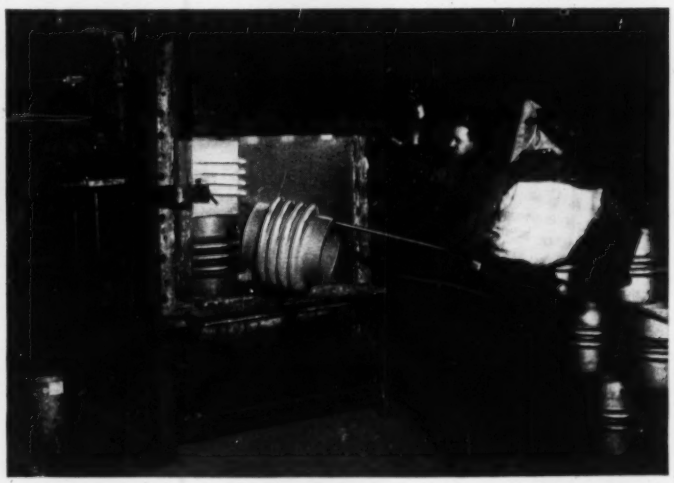
After the expansion joint cylinder has been formed, welded, and sized to exact dimensions (the length often being more than double that of the finished product), it is placed in one of several powerful hydraulic forming machines of our own design, which bulge the corrugations against accurately machined steel dies under extreme internal pressure at the same time the ends are forced toward each other. By this process, the additional metal required in the corrugations is obtained.

#### *Controlled Annealing*

After the final bulging operation, the expansion joints are given a full anneal to remove all stresses left by the forming operation. Proper heat treatment is essential to secure maximum potential expansion joint life. The corrugated element must be slowly and uniformly heated to a predetermined temperature, held at that temperature for a definite time, then cooled at a definite rate.

#### *Standard Method Unsatisfactory*

This cannot be accomplished successfully by heating the expansion joint with a torch until it shows an indefinite color. Yet, such is the method most often used in the manufacture of corrugated expansion joints. All Zallea Stainless Steel Expansion Joints are properly heat treated in one of several gas-fired furnaces of the type illustrated below. These furnaces are equipped with the most modern temperature controls, capable of maintaining a constant temperature at any point up to 2000° F., within 25 degrees. Recorders provide a permanent record of each heat. The control exercised in *every* phase of manufacturing Zallea Stainless Steel Expansion Joints assures dependable, long service life. When you want to be sure . . . always specify Zallea . . . you'll find it pays!



**Removing stainless steel expansion joint elements from furnace after annealing at 1950° F.**

# full branch tees

## ½ INCH THROUGH 30 INCHES

Ⓛ TO MARK PROGRESS

## ANOTHER IMPORTANT DEVELOPMENT in the LADISH LINE of

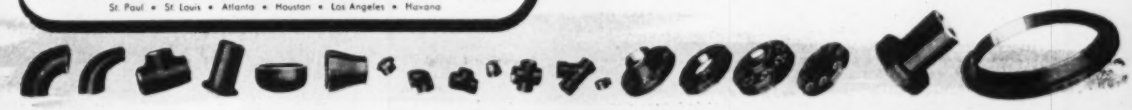
*Controlled Quality* **FITTINGS**

THE COMPLETE FITTINGS LINE
PRODUCED UNDER ONE ROOF...ONE RESPONSIBILITY

**LADISH CO.**
CUDAHY, WISCONSIN
MILWAUKEE SUBURB

DISTRICT OFFICES: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland • Chicago
St. Paul • St. Louis • Atlanta • Houston • Los Angeles • Havana

To increase safety, ease of installation and welding accessibility . . . Ladish Welding Tees have Full Branch Outlets with identical center-to-end dimension of branch and run as is required for each size *through 30 inches.* Scientific metal distribution . . . pioneered by Ladish . . . adds extra protection by equalizing stress over the entire fitting and assuring maximum strength in every cross section.



# It's Wilson's HAIR Filters

**FOR**

# temperature equipment

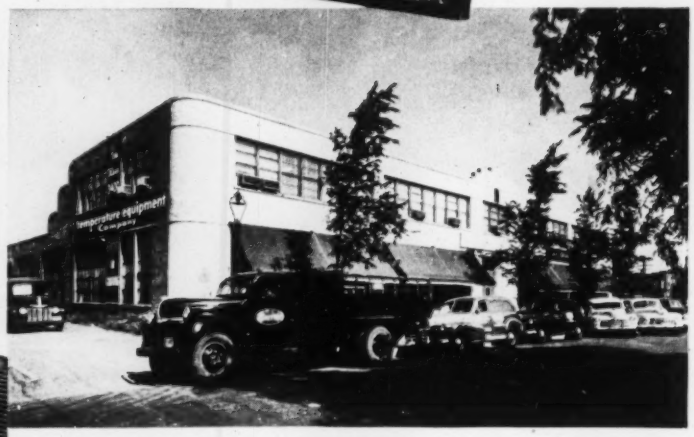
**Company**

**Exclusive distributors of**
**Carrier Air Conditioning & York Heat units**
**in Metropolitan Chicago**

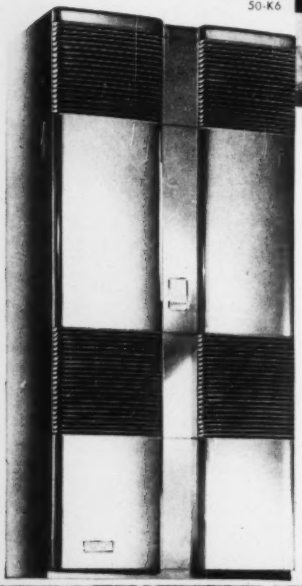
The famous Edgeseal. The Original *Hair* Filter with the patented self-sealing edge.

The popular Honeycomb, the dressed up *Hair* Filter that is so easy to handle.

This aggressive Sales Organization distributes complete lines of air conditioning and heating equipment to meet the ever increasing demand in these specialized fields. Wilson Edgeseal *Hair* Filters are used exclusively to insure maximum air cleansing efficiency in maintaining unexcelled unit performance. As with many other leaders, Temperature Equipment Company knows that Wilson *Hair* Filters deliver maximum cleaning without clogging—more cleaned air per filter.




Model No. 50-K6



## SAVE DELAY—DOUBT—DOLLARS

Send for samples with details and prices. Wilson *Hair* Filters are another quality product of Wilson & Co., Inc., famous for outstanding quality in meats, sports equipment, pharmaceuticals, hair products, etc.

**W. J. WAHL, owner (Skokie Air Filter Service) says:** "I have been servicing air filters in homes, plants and offices over twenty years. Two years ago I took on Wilson filters and have congratulated myself ever since. They not only give far more value per dollar, but are a *money-maker* and *time-saver* for me . . . save my hands, too."

**WILSON & CO., INC.**
**(Air Filter Division), 4100 S. Ashland Ave., Chicago 9, Illinois**

INDOOR COMFORT

**WILSON'S HAIR FILTER**

WILSON & CO.

**Setting new records for low-cost ventilation *Everywhere!***

# JOY AXIVANE* FANS

WITH JOY AXIVANE Fans, you profit by the greater efficiency, quieter and smoother operation, and lower power consumption of their vaneaxial design. You save on installation, too. These light, compact, in-line fans mount directly in the air duct—saving space and time, making foundations, guards, etc. unnecessary. What's more, the important adjustable-blade feature of JOY Fans gives you extra flexibility—permits easy adjustment on the job to suit new conditions or compensate for faulty duct work. ● Let us show you how to get *best* ventilating results!

Write for Bulletin, or

*Consult a Joy Engineer*

W&O 12358

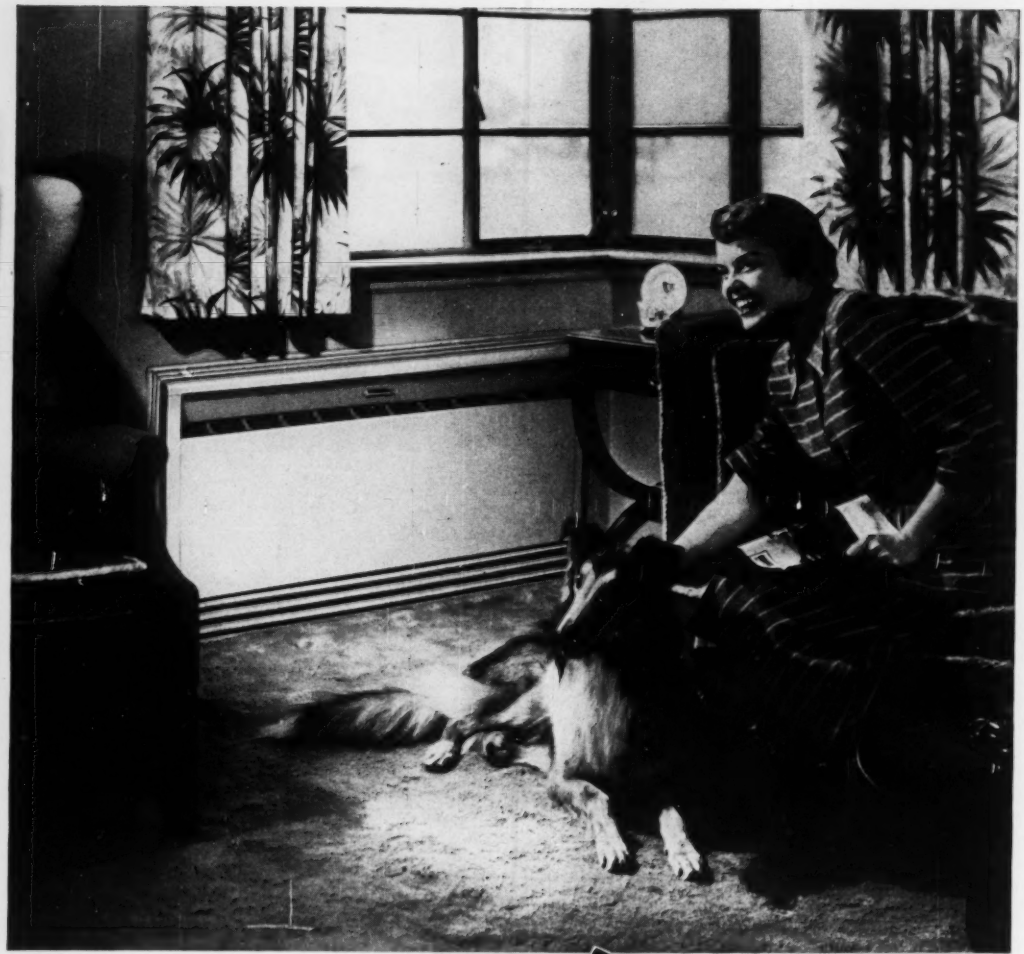
* *Reg. U.S. Pat. Off.*

## JOY MANUFACTURING COMPANY

GENERAL OFFICES: HENRY W. OLIVER BUILDING · PITTSBURGH 22, PA.

IN CANADA: JOY MANUFACTURING COMPANY (CANADA) LIMITED, GALT, ONTARIO

# Nothing heats better than Modine Convector Radiation . . . NOTHING LOOKS MORE BEAUTIFUL IN A BEAUTIFUL ROOM



*Design and Mechanical Patents Pending*

To find out why the new Modine Convector is the *better* way to heat apartments, homes, schools, offices or hospitals, call your Modine Representative. He's listed in the "Where-to-Buy-it" section of your phone book. Ask to see a sample, or write direct. Modine Mfg. Co., 1509 Dekoven Avenue, Racine, Wisconsin.

***Send for New Modine Convector Catalog Today!***

**Modine**
**CONVECTORS**

R-1061

# BRUNNER SINCE 1906 AIR CONDITIONING builds business

## "Packaged" AIR CONDITIONING

### . . . as easy to sell as cornflakes!

Air Conditioners are as much a part of the heating and plumbing contractor's business as cornflakes are a grocery store item...and as easy to sell.

Every business depending upon human traffic for the moving of merchandise recognizes customer comfort as the No. 1 attraction, therefore your potential customers are all those retail type businesses in the area you serve.

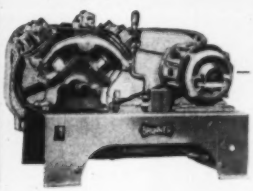
Brunner has the units . . . four popular sizes of self-contained air conditioners that provide you the *right* answers to every question of appearance, price, design, dependability and long self-amortizing service life. And packaged air conditioning is a clean and simple installation job.

● *Your letter requesting literature and complete information will lead the way to another source of good volume and good profits.*

**BRUNNER SINCE 1906**

## AIR CONDITIONING

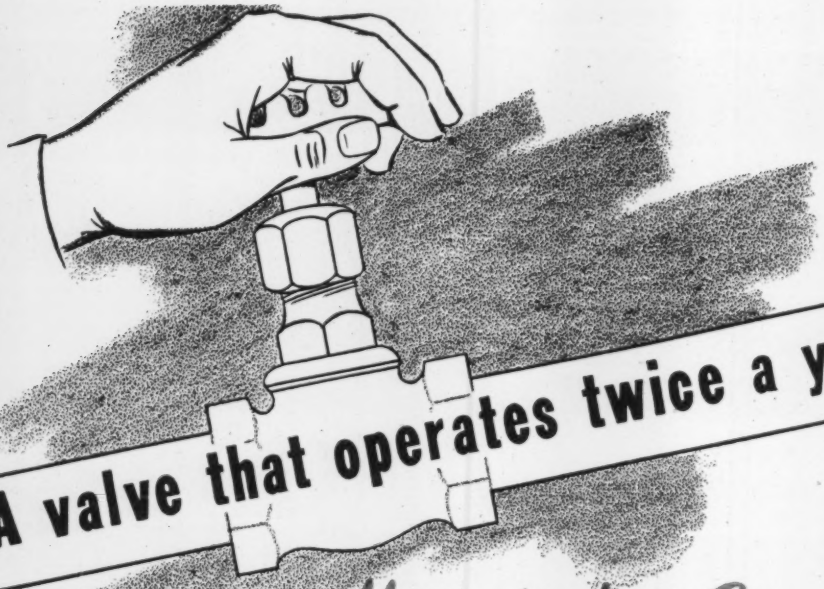
- **Self Contained 3 HP. to 10 HP.**
- **Remote Type 5 HP. to 75 HP.**



**BRUNNER MANUFACTURING CO., Utica 1, New York, U.S.A.**

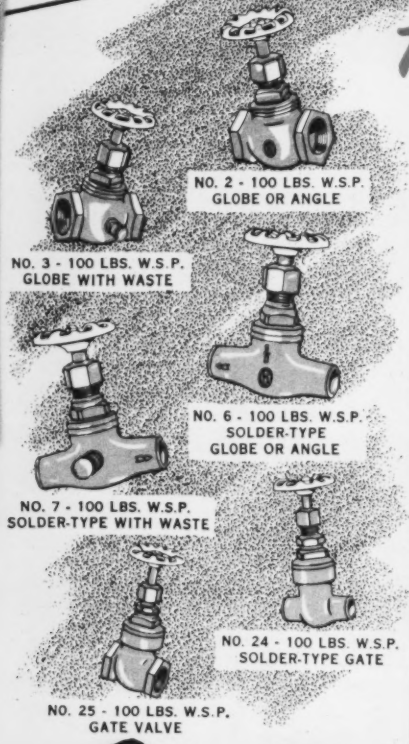
**REFRIGERATION CONDENSING UNITS by BRUNNER SINCE 1906**

**AIR AND WATER COOLED MODELS**—*a size and type for every purpose...*¼ **HP. TO 75 HP.**



# A valve that operates twice a year

## Has to be Good!


NO. 2 - 100 LBS. W.S.P.
GLOBE OR ANGLE
NO. 3 - 100 LBS. W.S.P.
GLOBE WITH WASTE
NO. 6 - 100 LBS. W.S.P.
SOLDER-TYPE
GLOBE OR ANGLE
NO. 7 - 100 LBS. W.S.P.
SOLDER-TYPE WITH WASTE
NO. 24 - 100 LBS. W.S.P.
SOLDER-TYPE GATE
NO. 25 - 100 LBS. W.S.P.
GATE VALVE

Most household valves are closed only once or twice a year—some even less. But this infrequent operation can be tougher on valves than the normal wear of valves used more often. On most valves left standing idle, the packing dries out and cracks, allowing water to leak through. The fibre discs in some valves often warp or come apart so that positive shutoff is impossible.

Be assured of a valve that can stand both the wear of frequent operation and the deterioration of long periods of idleness—install O-B valves instead of just any valve.

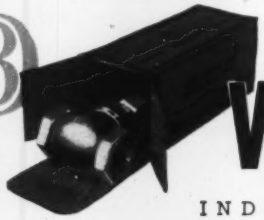
O-B valves are equipped with graphite-impregnated asbestos packing, which remains soft and pliable and resistant to leakage even when idle for several years. This packing is reinforced with lead and copper inserts for strength and long life.

Discs, too, are of the finest quality composition. On all cold or hot water plumbing and heating valves, O-B uses the same disc normally used on steam service—an extra precaution against warping or splitting, so common with the fibre discs used in many other valves.

A full line of plumbing and heating valves are stocked by your local O-B distributor. See him for your valve needs.

OHIO BRASS COMPANY, MANSFIELD 2 OHIO

4024-V



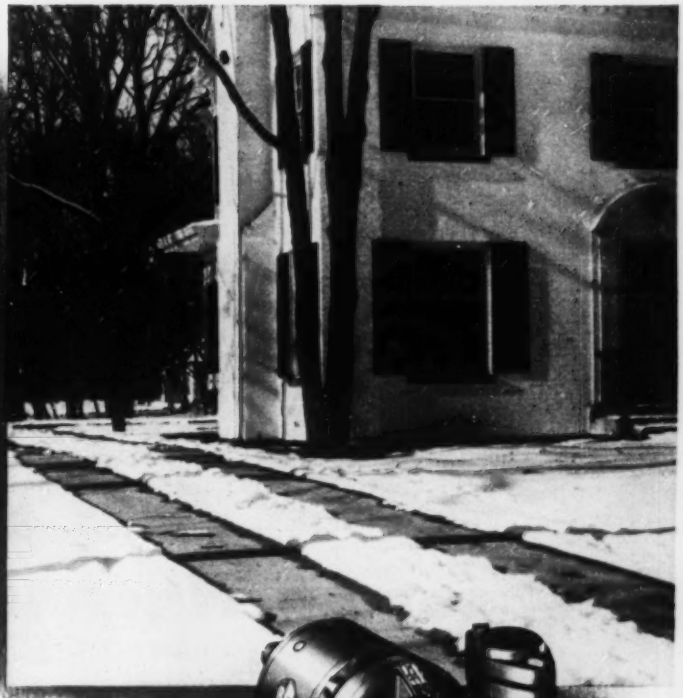
**Ohio Brass VALVES**

FOR DOMESTIC AND INDUSTRIAL USE

# SNOW MELTING

ANOTHER PLUS VALUE OF

## B&G Hydro-Flo Heating



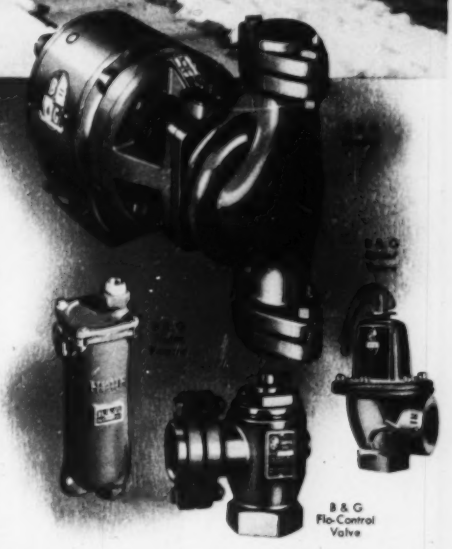
Here's one more reason why B & G *Hydro-Flo* Heating is tops in modern heating. Hot boiler water can be circulated by a B & G Booster through pipe coils under the driveway and sidewalk, melting snow as fast as it falls. Another tiresome job eliminated!

B & G *Hydro-Flo* Heating is known the country over for its outstanding advantages . . . *controlled radiant* warmth . . . fuel economy . . . supreme comfort in any weather! This forced hot water system permits a choice of baseboards, radiators, convectors or completely concealed radiant panels. Whatever your selection, you'll have the finest in automatically controlled heating.

The B & G *Hydro-Flo* System matches the heat supply to the weather—so exactly that from Fall to Spring, indoor temperature is held constantly at the comfort level. And besides, it provides a year-'round supply of hot water for kitchen, laundry and bath.

**NO JOB TOO BIG OR TOO SMALL**

Hundreds of thousands of B & G *Hydro-Flo* Systems are in operation today. You'll find them in low-cost homes, apartments, industrial and commercial buildings, delivering the same comfort regardless of the size of the building.




**B & G HYDRO-FLO HEATING EQUIPMENT**

The basic units of a B & G *Hydro-Flo* System are simple and dependable—an assurance of long years of trouble-free service. Any hot water boiler—new or old—can be equipped with B & G *Hydro-Flo* Products.

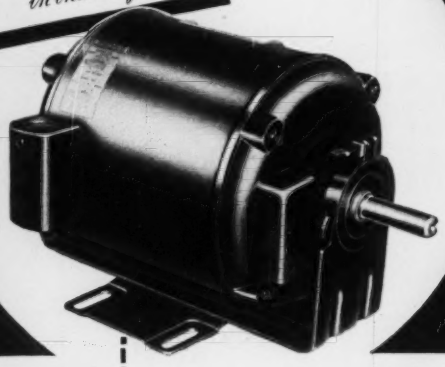
**BELL & GOSSETT** Company

Dept. BP-5, Morton Grove, Ill.

*Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Road, Toronto 13, Canada*

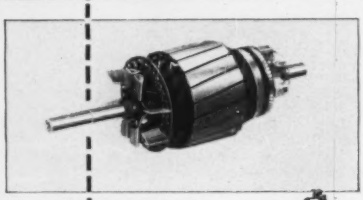
*Reg. U. S. Pat. Off

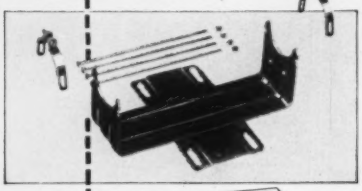
WAGNER MOTORS
*...The choice of leaders in industry*



**Power Your Product With Dependability**

# Choose a Wagner Motor





Every painstaking step in the construction of Wagner Motors reflects the sound engineering and good workmanship that have made them famous for quality and durability for almost sixty years.

Wagner Motors are available in a wide range of types and sizes for every application. They are compactly built without sacrificing strength or efficiency and are the first choice of many manufacturers because of their dependable performance.

If you need motors that will give long, trouble-free performance and build customer satisfaction—choose Wagner Motors. Bulletin MU-185 gives complete information.

* * *

Buyers of Wagner Motors get Nationwide Service! More than 450 Wagner Authorized Electrical Service Stations and Parts Distributors augmented by 25 Wagner-owned Service Branches are ready to supply on-the-spot service, replacement motors, or genuine Wagner Parts. Write for Bulletin MU-24 for the complete list of names and locations.

**WAGNER ELECTRIC CORPORATION**
**6370 Plymouth Ave., St. Louis 14, Mo., U.S.A.**

Wagner Electric Corporation
EST. 1891

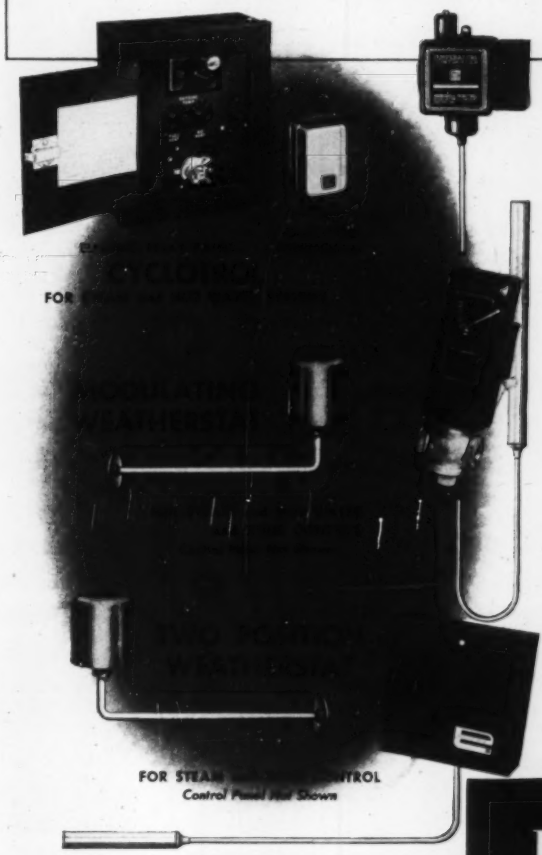
ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS — AIR AND HYDRAULIC

**BRANCHES IN 29 PRINCIPAL CITIES**

MU-1

# Not Only the Best . . . but the Most Complete Line!

## Honeywell Outdoor Temperature Controllers



AQUATROL
FOR HOT WATER SYSTEMS

THERE is an outdoor temperature control system tailor made for every type of building and for every type of fuel—and Honeywell makes it!

Not only is the Honeywell line the most complete, but each individual system is outstanding in its field.

Four basic Honeywell outdoor temperature control systems are available. The new Honeywell Electronic Cyclotrol system is a low cost outdoor controller for steam and hot water systems. The Modulating Weatherstat system is designed for steam, hot water and zone control, while the two position Weatherstat is suitable for steam and zone control. The Aquatrol system is for hot water systems only. All meter the supply of heat in accordance with the weather—delivering less when the outdoor temperature is higher and more when it is colder.

When you think of outdoor control, think of Honeywell. Remember, Honeywell, and only Honeywell, can give you an outdoor control system tailor made for every requirement.

MINNEAPOLIS
**Honeywell**
CONTROL SYSTEMS

73 BRANCHES FROM COAST TO COAST WITH SUBSIDIARY COMPANIES IN: TORONTO • LONDON • STOCKHOLM • AMSTERDAM • BRUSSELS • ZURICH • MEXICO CITY

DO YOU WANT
THE FACTS?

MOST EFFICIENT INSULATED PIPING SYSTEMS

Piping designers and engineers responsible for the efficient operation of steam or hot water heating systems, industrial and commercial processing systems, will find the complete descriptive engineering information used in the design of underground steel duct banks recently published by Ric-wil, Prefabricated Insulated Piping Systems.

Appreciation of these facts is in keeping with Ric-wil's policy established forty years ago of providing not only the finest insulated piping and accessories but also complete technical information for users of Ric-wil products.

There are five books in the series, each of which deals with specific phases of insulated piping design, engineering, and installation.

Section 400-2—Engineering Data—A comprehensive data book containing pertinent engineering data as applied to insulated piping and steam distribution.

Section 400-3—Typical Engineering Drawings—Contains a series of typical engineering drawings of insulated piping.

Section 400-4—Insulated Piping Systems Catalog—Contains pertinent general information about Ric-wil Prefabricated Systems, with complete descriptions of the products, their dimensions, specifications, and their values in heating, refrigeration, and processing.

Section 400-5—Ric-wil Tile and Cast Iron Fittings—Contains complete illustrated and descriptive material dealing exclusively with Ric-wil Tile and Cast Iron fittings, their applications and specifications.

Section 400-6—Specifications Data—This book contains specifications for all types of insulated piping and installation procedures.

Copies of any of the described books are available. Write to Dept. I-7, The Ric-wil Company, Cleveland, Ohio.

40th YEAR DEPENDABLE INSULATED PIPING SYSTEMS 1910 · 1950

RIC·WIL
INSULATED PIPING SYSTEMS
THE RIC-WIL COMPANY · CLEVELAND, O.
OVERHEAD
UNDERGROUND

FOR FORTY YEARS THE GREATEST NAME IN INSULATED PIPING SYSTEMS

# It's no time to fiddle!

HEADLINES warn us of the menace of spies and subversive agents. But in every community there is a hazard, largely unrecognized, which may become ready tinder for the ravaging flames of socialism and communism. This is the misconception of everyday economic facts that exist among our young people.

For example, a recent poll among high school seniors shows that the majority of them believe that the owners of business take out for themselves a larger share of the income than is paid to employees. They think the stockholders' average return is 24% of the sales dollar. The truth is that stockholders average less than 3%, whereas over 30% of the income dollar is paid out as wages, pensions and other benefits.

Our young people do not seem to realize that paying dividends is only one function of profits. Far more important today is the need for profit to keep business competitive, and to pay for new buildings, machinery, and other necessary equipment and to provide new and more jobs. Ignorance of this fundamental concept breeds contempt for the system of enterprise that built our country and keeps it strong.

The facts of business must be given to our boys and girls to protect their future. Only business men can supply the facts. As a business leader in your community, it is your responsibility to help clear up such misconceptions. The old story that Nero fiddled while Rome burned must not have a counterpart in America.

THE YOUNGSTOWN SHEET & TUBE CO. 1900 YOUNGSTOWN 1950 50 YEARS OF SERVICE

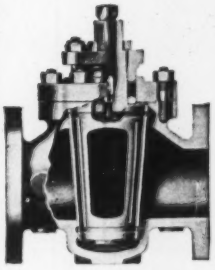
## The Youngstown Sheet and Tube Company

General Offices--Youngstown 1, Ohio
Export Offices--500 Fifth Avenue, New York

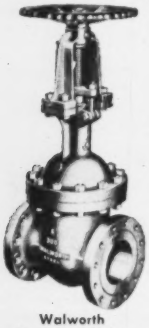
MANUFACTURERS OF CARBON ALLOY AND YOLOY STEELS

RAILROAD TRACK SPIKES - CONDUIT - HOT AND COLD FINISHED CARBON AND ALLOY BARS - PIPE AND TUBULAR PRODUCTS - WIRE - ELECTROLYTIC TIN PLATE - COKE TIN PLATE - RODS - SHEETS - PLATES.

# ● VALVES
# ● PIPE FITTINGS

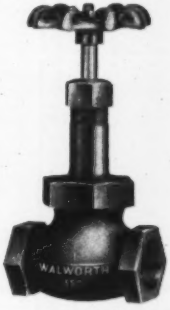


Walworth
Lubricated Plug Valve



Walworth
Steel Gate Valve

Walworth
Iron Body Gate Valve



Walworth
"500 Brinell" Bronze Globe Valve

Walworth
Iron Body Saddle Gate Valve

Walworth
Cast Steel Flanged Fittings

Walworth manufactures a *complete line* of valves and pipe fittings: all made to the highest standards of quality, both as to dimensional accuracy and metallurgical properties. In design, construction, and performance, Walworth products reflect more than a century of experience in the manufacture of quality valves and fittings.

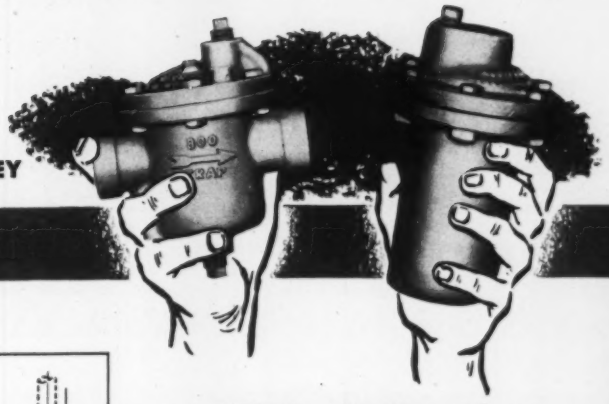
Your Walworth distributor will give you full information on the *complete line* of Walworth steel, iron, and bronze, and special alloy valves and pipe fittings; also Walworth Lubricated Plug Valves, and Walseal* valves, fittings and flanges. Ask for this information today.

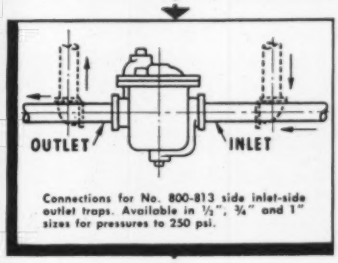
*Patented—Reg. U. S. Pat. Off.

**WALWORTH**
**valves and fittings**
**60 EAST 42nd STREET, NEW YORK 17, N. Y.**

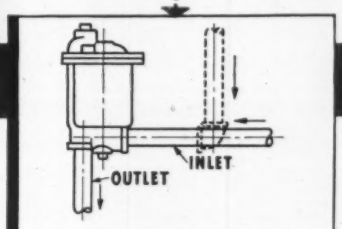
DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

YOU SAVE
TIME AND MONEY

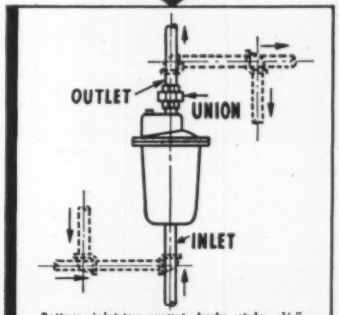





Connections for No. 800-813 side inlet-side outlet traps. Available in ½", ¾" and 1" sizes for pressures to 250 psi.




Side inlet-bottom outlet trap, ½" or ¾". Greatly simplifies connections to many types of small steam-consuming units.




Bottom inlet-top outlet body style. ½" through 2" connections. Cast semi-steel bodies for pressures to 250 psi. Forged steel bodies for pressures to 1500 psi.

## "This choice of Steam Trap Body Styles simplifies installations"

IN THE most widely used sizes, Armstrong Steam Traps are available in either side inlet-side outlet or bottom inlet-top outlet body styles. This gives the user an opportunity to make exceptionally neat installations with a minimum of fittings and a minimum of labor and permits correct location of the trap in relation to the unit being drained.

In both styles the entire interior mechanism may be taken out for inspection or repair simply by removing the cap. The body, full of boiling water, is left in the line. In the case of the side inlet trap the cap may be removed without even disturbing the pipe connections.

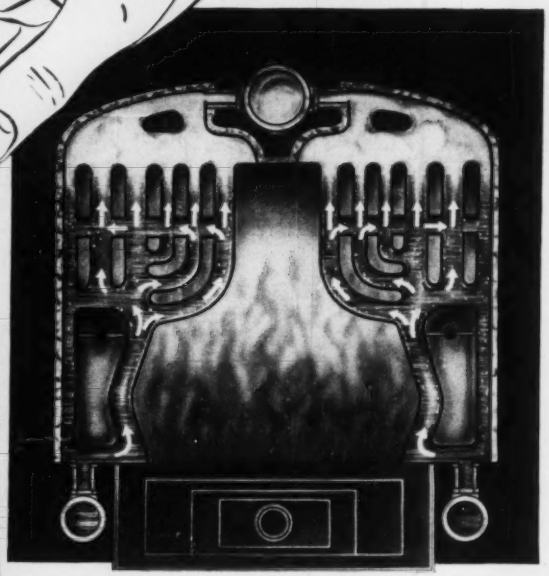
Ask your nearby Armstrong representative to show you the opportunities for simplifying trap installations.

**ARMSTRONG MACHINE WORKS**
874 Maple St., Three Rivers, Mich.

THE 36-PAGE ARMSTRONG STEAM TRAP BOOK gives data and prices on the complete line of Armstrong steam traps for every pressure, every application. This book is a valuable reference for the calculation of condensate loads and the selection of traps for all classes of equipment. Send for free copy today

# ARMSTRONG STEAM TRAPS

# HOW LONG COULD YOU HOLD ON?

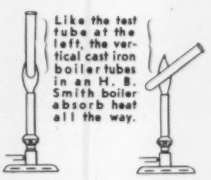


## HOT GASES WORK ALL THE WAY UP IN H. B. SMITH BOILERS

. . . just the way they flow up this test tube held over the Bunsen burner. In a matter of seconds you'd have let go.

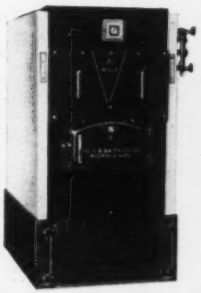
That's one reason why H B. SMITH cast iron boilers are designed with large vertical cast iron water tubes — for faster heat absorption all the way up and completely around every tube.

There are other reasons of course. 1) Less soot clings to the smooth vertical tubes —they are virtually self-cleaning. 2) Water tube design means maximum heating surface. 3) Properly proportioned channels between the tubes permit free passage of the hot gases with low draft loss. 4) Sections are all grey iron for low maintenance —long life. H. B. SMITH boilers have been in service for more than 65 years. 5) Header type construction permits operation with one or more sections out of service, if necessary.

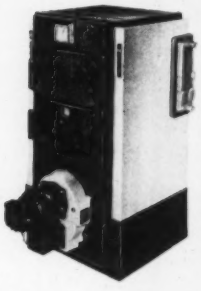


Like the test tube at the left, the vertical cast iron boiler tubes in an H. B. Smith boiler absorb heat all the way.

. . . all good reasons why Smith Engineered Boilers give more heat per fuel unit, use less fuel, and cost less to operate. For all the reasons write for free catalogue today.

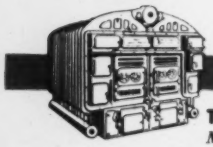


SMITH-MILLS "20" BOILER for Hand Firing. Four models for steam heat, four models for hot water heat — each equipped with built-in water heater for unfailing supply of domestic hot water.



SMITH-MILLS "100" BOILER-BURNER UNIT. A complete heating plant for the average home—four models in steam, in hot water heat. Equipped with oil burner and tankless heater or tank connections. Extended type jacket available.

You may be interested to know that H. B. Smith manufactures the most complete line of modern cast iron boilers in the world. Let us help you satisfy your customers with convincing data and case histories.



H. B. Smith

**CAST IRON BOILERS**

**THE H. B. SMITH CO. INC., WESTFIELD, MASS.**

*Most complete line in the world of cast iron boilers for heating*

# D. A.*

An HONORARY DEGREE Conferred on

MIDWEST

WELDING ELBOWS

*By Pipe Welders Everywhere*

Pipe welders who know Midwest Welding Elbows have conferred upon them an honorary degree unique in piping . . . "D. A." for "dimensional accuracy".

This degree was earned for Midwest Elbows by their unique process of manufacture. In this process, developed by Midwest, the elbow is first made slightly oversize. After welding it is reheated to forging temperature and brought to final size in compression dies. This relieves forming and welding stress . . . assures true circular cross-section, controlled wall thickness and accurate radius, included arc and tangents. The elbows are beveled on special machines which cut both ends simultaneously, holding exact included angle and center-to-end dimensions.

"D. A." is a degree which means a lot to pipe welders. It means that they don't have to waste time lining up inaccurate fittings. It means that they don't have to spend time and weld metal in compensating for bad fit. And it means that they can produce better, cleaner, stronger welds with less trouble.

"D. A." saves money for you when it saves time and trouble for welders. Use Midwest "D. A." Elbows on your next job. Call your Midwest Distributor; there is one conveniently near you.

**MIDWEST PIPING & SUPPLY CO., Inc.**

MAIN OFFICES: 1450 SO. SECOND STREET, ST. LOUIS 4, MO.
Sales Offices: New York 7—30 Church St. • Chicago 3—79 W. Monroe St. • Los Angeles 33—520 Anderson St. Houston 2—1213 Capitol Ave. • Tulsa 3—533 Mayo Bldg. Boston 27—426 First St. • Stocking Distributors in All Principal Cities

* Dimensional Accuracy

MIDWEST WELDING FITTINGS IMPROVE DESIGN AND REDUCE COSTS

# Did you know ALUMINUM

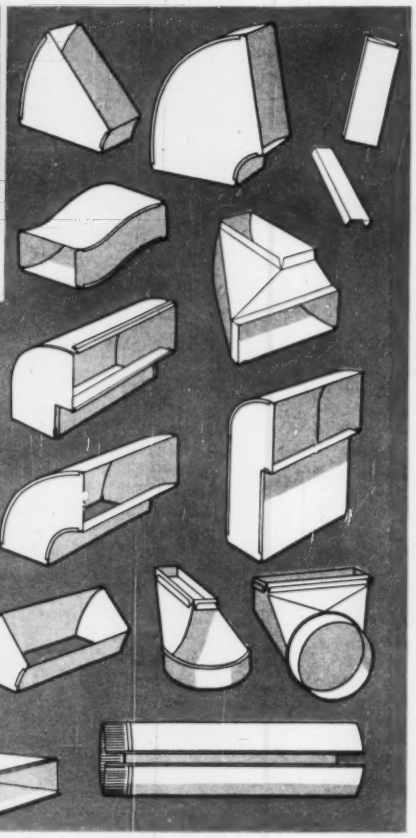
## PREFABRICATED FITTINGS

## COST NO MORE THAN GALVANIZED

## . . . and neither should a complete duct system —home or commercial

*Corrosive fumes won't eat into these aluminum exhaust stacks, but they'd murder many another metal. Aluminum is best in industrial atmospheres.*

*Typical installation of aluminum ductwork serving a modern automatic heating plant in a private home.*



SUPPOSE you were told that you could save by supplying ALUMINUM ductwork—save 3 ways—save money—save time—save effort!

Here's why: to start with, Reynolds Aluminum has *three* times the working surface per pound of any other metal you can use. Every conceivable shape and size of prefabricated fitting is available in aluminum.* That eliminates waste and scrap handling for you. Or you can fabricate your own and still save with Reynolds Aluminum.

On the job Reynolds Aluminum is so light it speeds up the work—helps you complete more jobs—and on schedule. You're less tired at the end of the day. Besides, aluminum fabrication doesn't require any special equipment.

And with all this, Reynolds Aluminum gives you the mighty "plus" advantage of customer praise for quality work. They get a clean, smooth, gleaming job—no need for painting—never a rust problem. Inner surfaces are smooth, assure maximum air delivery, faster heat transmission. And the dual-insulating qualities of aluminum not only prevent excessive temperature losses but *actually deaden noise* when ducts are properly installed. Of course, it's approved for F.H.A. financing.

For more information and friendly service call the Reynolds distributor or Reynolds office listed in classified telephone directories under "Aluminum". Write direct for the helpful 32 page booklet, "Aluminum in Heating, Ventilating and Air Conditioning". Reynolds Metals Company, 2566 South Third Street, Louisville 1, Ky.

**Names of aluminum prefabricated fitting manufacturers will be sent on request.*

REYNOLDS METALS

**REYNOLDS *Lifetime* ALUMINUM**

CONSIDER ALUMINUM • CONSULT REYNOLDS • THE COMPLETE ALUMINUM SERVICE

Three Carrier 46R7 Heat Diffusers serve the Enameling Room in the Magnet Wire Department, Buckthorn Plant, John A. Roebling's Sons Co., Trenton, New Jersey.

# THIS LOW-COST HEAT DOESN'T COLD-SHOULDER CORNERS!

It's no problem reaching corners of large-area buildings with Carrier Heat Diffusers. Their multiple discharge outlets and adjustable louvers direct heat evenly where it's needed, under all conditions at full or partial loads.

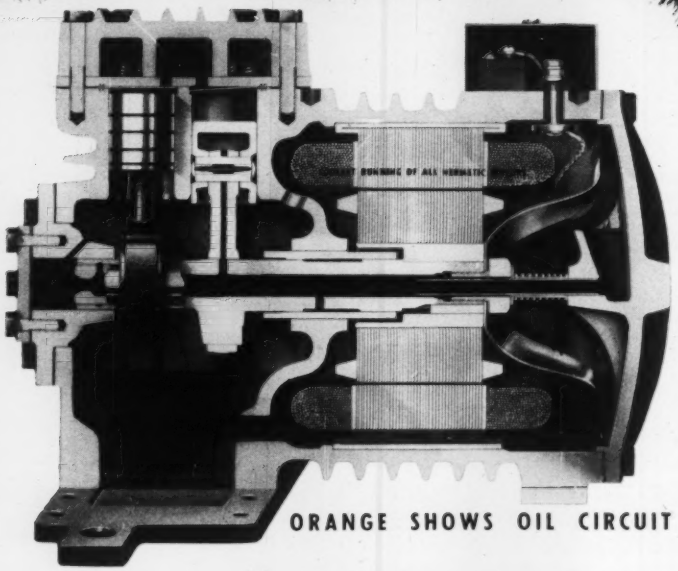
Equally important, Carrier Heat Diffusers are substantial fuel savers. Their heat flow is under exact control, either through Carrier non-freeze steam distributing tube coils and modulating valves or through Carrier Thermadjust with modulating electric control at full steam pressure. They are also adaptable to drying and ventilating. Available in capacities from 115,000 to 1,570,000 Btu's per hour, they are shipped in complete assembly, ready to operate—and no duct work is required. Sectional design provides floor or suspension mounting with vertical or horizontal discharge.

Carrier has built superior performance and long life into these rugged Heat Diffusers to make them a good investment for your customers—and a good product for you to sell. Carrier Corporation, Syracuse 1, New York.

Carrier

AIR CONDITIONING
REFRIGERATION
INDUSTRIAL HEATING

# FOR QUIET, ECONOMICAL AIR CONDITIONING



ORANGE SHOWS OIL CIRCUIT

# COPELAMETIC

## The ACCESSIBLE Hermetic

Smooth, quiet Copelametic gives the greatest value for your air-conditioning dollar. Look over the BTU ratings and you'll see what we mean. Copelametic is the hermetic that combines all the finest features of all types of units. It is field-accessible . . . never a reason to return it to the factory.

Copelametic eliminates belts, seals and manual motor oiling. The cutaway illustration shows how oil reaches all bearing surfaces by forced-feed lubrication. The one-piece compressor and motor housing maintains perfect alignment for bearings and cylinders. Large integral cast fins around the housing dissipate heat rapidly for highest efficiency. In addition, motors are water-cooled above 2 H.P.

Copelametic units can be used on any application now served by open units. Motors for any standard currents. Models from 1/6 H.P. to 7½ H.P., inclusive.

WRITE, WIRE or PHONE for full details.

**COPELAND REFRIGERATION CORPORATION · SIDNEY, OHIO**

*Manufacturers of*

**REFRIGERATION UNITS (OPEN-TYPE AND COPELAMETIC), WATER COOLERS, REFRIGERATORS**

# Tri-Flex Aerovane

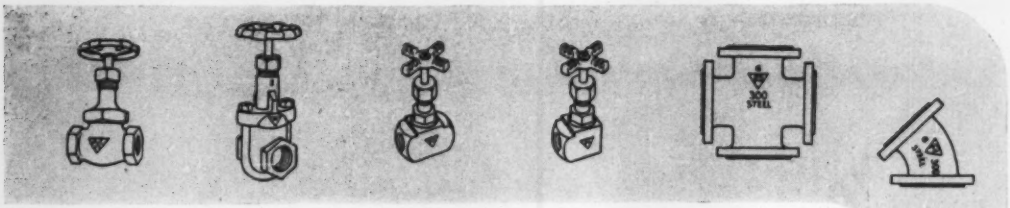
## in 100 Park Avenue

. . . one of New York City's newest and most impressive skyscrapers, an outstanding example of modern trends in structural design, efficiency, comfort. Completely air conditioned, the 36-story tower is equipped throughout with T&B Standards . . . Tri-Flex and Aerovane Grilles and Registers . . . specified by men who know the important relation between the satisfactory performance of an air conditioning system and the distribution equipment they select. With T&B Standards in-[illegible], they can be sure of maximum, flexible [illegible] of air delivery to meet every requirement . . . another trouble-free job!

For quick selection . . . economy . . . prompt delivery . . . specify and install Tri-Flex and Aerovane Grilles and Registers. For complete details and engineering data, write for Catalog 48S.

TUTTLE & BAILEY INC
NEW BRITAIN, CONNECTICUT

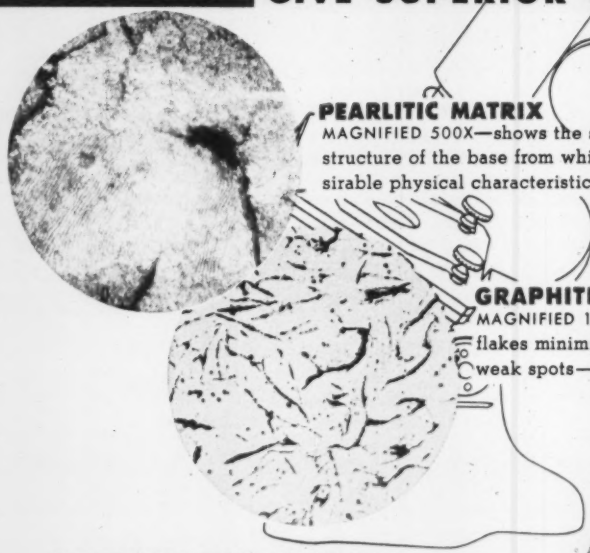
ST950



THE MICROSCOPE SHOWS WHY

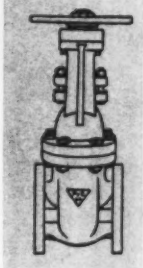
# R·P&C Electric Iron Valves

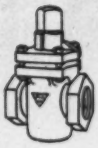
GIVE SUPERIOR SERVICE



**PEARLITIC MATRIX**
MAGNIFIED 500X—shows the sound banded structure of the base from which the desirable physical characteristics come.

**GRAPHITE FLAKES**
MAGNIFIED 100X—fineness of graphite flakes minimizes possibility of weak spots—results in stronger iron.





**CLOSE ANALYSIS CONTROL**
—possible in the electric furnace—results in a pearlitic matrix, evenly distributed graphite, minimum sulphur and phosphorus, superior iron, sound castings, high quality valves. All R-P&C IRON VALVES are made of Electric Cast Iron.

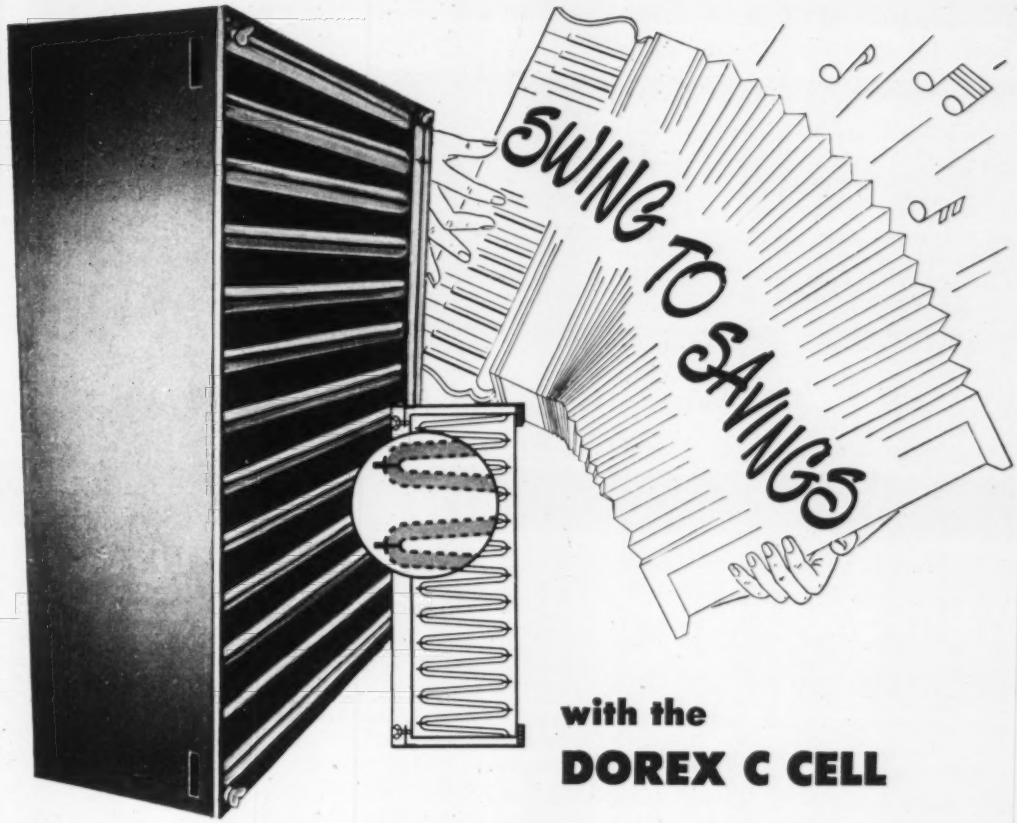
*Ask your R-P&C Distributor for copies of these Bulletins* **DH-8** *and* **DH-136** *which describe in more detail the* **R-P&C** *line of Iron Valves*

**ACCO** Reading, Pa., Atlanta, Baltimore, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

**R-P & C VALVE DIVISION**
**AMERICAN CHAIN & CABLE**

TRADE MARK

**READING-PRATT & CADY VALVES**




## with the DOREX C CELL

Accordion pleating plays a big part in keeping efficiency up, costs down. When you install Dorex Type C Air Recovery Cells in air conditioning systems and units, the most effective air purifier known—*activated* carbon—is put to work in the most effective way. Accordion-pleated beds expose maximum surface area.

This special Dorex *activated* carbon extracts all gaseous and odorous impurities from the air that passes through it—makes stale air completely fresh and re-usable. This means that the amount of new air that has to be taken in can be reduced by as much as two-thirds. *And the cost of Dorex Air Recovery is only one-fourth the cost of conditioning an equivalent amount of outside air!*

More than 6,000 users—leaders in business everywhere—now use Dorex Air Recovery. Their savings in capital expenditure for air conditioning equipment have been great; and they continue to save millions annually in operating costs. Architects, engineers and contractors have been recommending Dorex Air Recovery for more than 20 years.

Have all the facts about Dorex Air Recovery on file. Mail the coupon today.

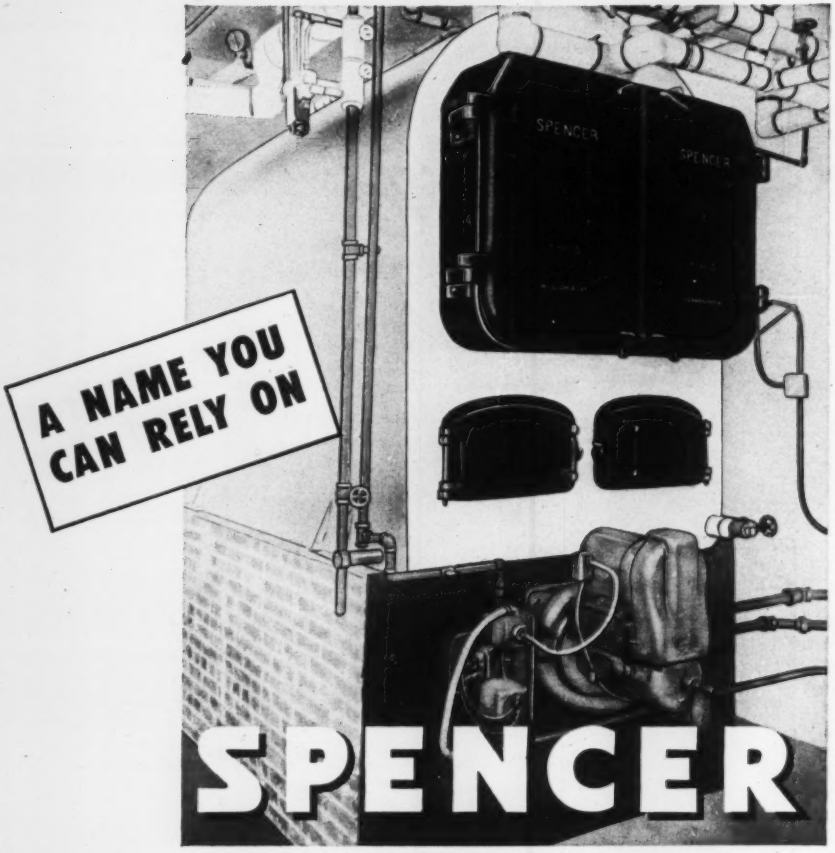
DOREX
REG. U. S. PAT. OFF.
*Air Recovery*

W. B. CONNOR ENGINEERING CORP.
114 East 32nd Street, New York 16, N. Y.
*Air Diffusion • Air Purification • Air Recovery*
In Canada: Douglas Engineering Co., Ltd.,
190 Murray Street, Montreal 3, P. Q.

TRADE MARK "DOREX" REG. U. S. PAT. OFF.

W. B. CONNOR ENGINEERING CORP.
Dept. A-70, 114 East 32nd Street, New York 16, N. Y.
Please send me, without obligation, full information on Dorex Air Recovery.

Name.....
Position.....
Company.....
Street.....
City.....Zone.....State.....




## THE QUALITY LINE OF

# HEATING BOILERS

### VERSATILE

Boilers for all types of fuel and all methods of firing. Capacities from 290 to 45,000 square feet, steam.

### DEPENDABLE

Precision-engineered and manufactured to give superior, *guaranteed* service.

**THERE IS A SPENCER FOR *EVERY* BUILDING FOR *EVERY* FUEL**

**Including 34 Steel Heating Boilers for Commercial Installations**

**SPENCER HEATER**
**LYCOMING-SPENCER DIVISION**
WILLIAMSPORT LYCO PENNSYLVANIA

*Write for free catalog today*

Constructed in accordance with ASME requirements. Fully approved by Steel Boiler Institute or Institute of Boiler and Radiator Manufacturers

SBI

use these facts and

# YOUR OWN FIGURES

## TO LOWER AIR FILTERING COSTS

Cleanable filters vs. DUST-STOP replacement-type filters . . . which is the lower in cost? You needn't guess . . . it's easy to figure the answer accurately. Just insert your own figures in the analysis form contained in the DUST-STOP "Comparative Study of Air Filtering Costs in Central Systems"—see how you can save money with DUST-STOPS. Use the coupon below for your free copy.

As you know, rising labor costs have made filter cleaning more expensive, on the other hand, mass production has lowered the cost of DUST-STOP Filters. As the "Comparative Study" shows, a cleanable filter would have to last *up to 14 years* (on the basis of one 40¢ cleaning every 90 days) in order to bring its cost down to the cost of DUST-STOP Filters replaced at the same intervals. Furthermore, your DUST-STOP system is made "brand new" every time you change the filters.

***Check your air filtering costs—***
***send for a copy of this study today.***

UL LABORATORIES

# DUST STOP*

AIR FILTERS

a FIBERGLAS* product

*DUST-STOP is the trade-mark of Owens-Corning Fiberglas Corporation for impingement-type air filters made of glass fibers. FIBERGLAS is the trade-mark (Reg. U.S. Pat. Off.) of Owens-Corning Fiberglas Corporation for a variety of products made of or with glass fibers.

Owens-Corning Fiberglas Corporation
Dept. 40-G
Toledo 1, Ohio

Gentlemen: Please send me a copy of your "Comparative Study of Air Filtering Costs in Central Systems".

NAME _____

FIRM _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

# WHEATLAND STEEL PIPE

## IS ON THE JOB— *EVERYWHERE!*

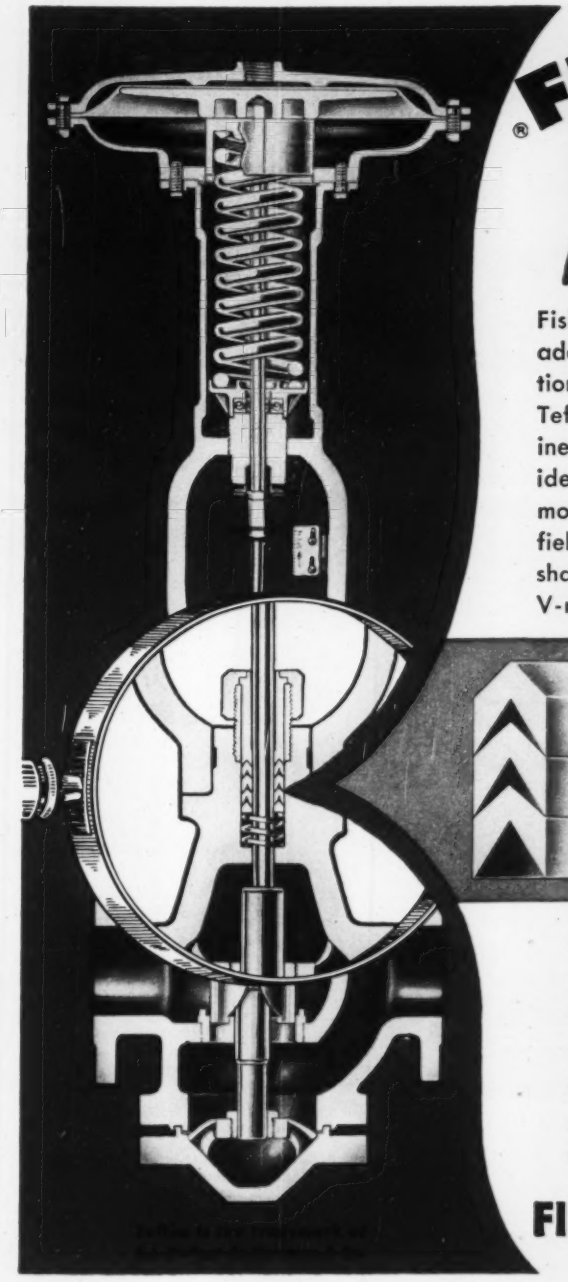
All over the U.S.A. new homes, new housing projects, new schools, new hospitals, new factories are rising—and you'll find steel pipe at work in them all. We at Wheatland are proud that "the pipe with the yearmark" is on the job everywhere silently, dependably, economically contributing to the health, comfort, and efficiency of the nation.

**WHEATLAND TUBE COMPANY**

**Bankers Securities Bldg., Juniper and Walnut Sts., Philadelphia 7, Pa.**

*-pipe with the yearmark!*

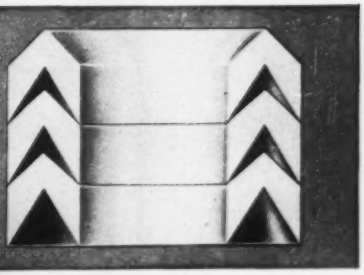
# IT'S *New* AND A *Natural*



## FISHER ® *Teflon*

## *V-RING PACKING*

Fisher Teflon V-ring Packing has been adopted as standard available construction for all Fisher diaphragm motor valves. Teflon is tough, resilient, and chemically inert. Its smooth soap-like surface makes it ideal packing for control valves. After more than two years of laboratory and field testing Teflon in various forms and shapes, Fisher engineers decided upon the V-ring construction as ideal for packing.



Fisher Teflon packing cut in section to show V-ring construction.

**Advantages of Fisher Teflon V-ring packing:**

- ***Economical***
- ***Minimum leakage***
- ***Low maintenance***
- ***Reduction of packing friction***
- ***No corrosion***
- ***No product contamination***

**FISHER GOVERNOR CO.**

**MARSHALLTOWN, IOWA**

# Taco's Horizontal goes HY-DUTY

SAME INTERCHANGEABILITY OF FLANGES AND OTHER QUALITY FEATURES OF TACO CIRCULATORS

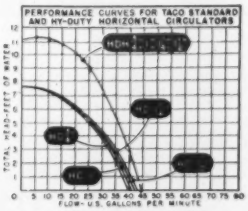
## DESIGNED FOR LONG RUNS, RADIANT PANELS AND OTHER HIGH RESISTANCE JOBS

*Pumps 20 GPM against 10' head*

**SAVE MORE MONEY**
**With Taco Venturi Fittings**

You use only one Taco Venturi fitting to a radiator . . . on the return. Use same one on downfeed as you use on upfeed radiators.

iT'S A BIG BROTHER TO TACO'S "HC" STANDARD WHICH PUMPS 5 GPM AGAINST 7½' HEAD


PERFORMANCE CURVES FOR TACO STANDARD AND HY-DUTY HORIZONTAL CIRCULATORS
TOTAL HEAD-FEET OF WATER
FLOW-U.S. GALLONS PER MINUTE
HC

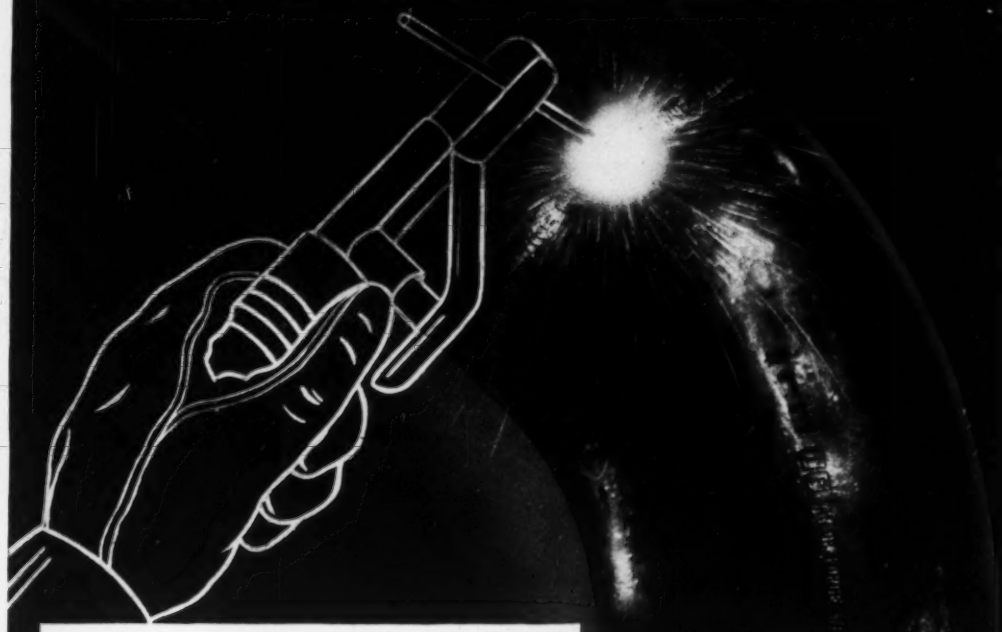
**SEND FOR THIS BOOKLET . . .**

Gives accurate engineering for one pipe hot water jobs in easy-to-use tables.

*Better Heating-Better with Taco*

**TACO HEATERS, Incorporated**
**137 South St., Providence 3, R. I.**

# WeldELLS®



## ...There are no fittings like WeldELLS

When we say there are no welding fittings like WeldELLS we feel that we are simply repeating the expressed opinions of thousands who know pipe welding.

Often it is the opinion of a designer who recognizes the engineered strength distribution and closely controlled metallurgy of these fittings that are designed by engineers.

Frequently, it is the opinion of a construction superintendent, maintenance man, or welding foreman who has discovered job-speeding, cost cutting features in WeldELLS that are combined in no other fittings.

Sometimes it is the opinion of those whose unusual requirements can only be satisfied in the broader Taylor Forge line; for in certain sizes, weights and materials it can be truthfully said that *there are no fittings* BUT *WeldELLS!*

**TAYLOR FORGE & PIPE WORKS**
P. O. Box 485, Chicago 90, Illinois
Offices in all principal cities: Eastern Plant: Carnegie, Pa. Western Plant: Fontana, Calif.

Taylor Spiral Pipe is again promptly available in a broader range of sizes and thicknesses. Coupon brings pipe bulletin.

☐ Please send new Catalog 484 covering welding fittings and forged steel flanges.
☐ Send new Bulletin 493 covering Taylor Spiral Pipe and related fittings.

NAME _____
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COMPANY _____
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CITY _____ ZONE _____ STATE _____

*Mail to Taylor Forge & Pipe Works, P. O. Box 485, Chicago 90, Ill.*

510-0750

# TAYLOR FORGE

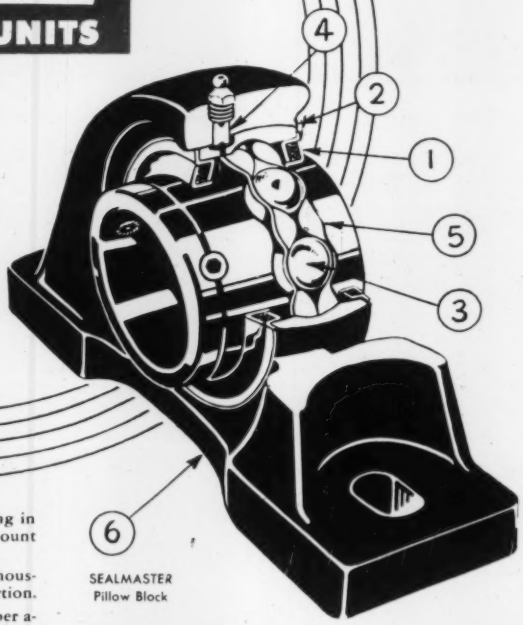
# DEPENDABLE

## 6 features assure unexcelled performance from

# SEALMASTER
## BALL BEARING UNITS

Good bearing performance...quiet operation... long life and low maintenance are all results of the combination of design and construction features found only in SEALMASTER units. Fans, blowers and all types of similar equipment perform better, last longer and give customer satisfaction when equipped with SEALMASTERS.

Check the list below and then write us for a copy of catalog 845 . . . it gives complete details on the entire SEALMASTER line, including dimensions and load ratings.




SEALMASTER Pillow Block

**SPECIFICALLY,** *Here's Why SealMasters Excel:*

1. **PERMANENTLY SEALED!** Felt-lined steel flinger rotating in labyrinth prevents entry of dirt and retains proper amount of lubricant.
2. **SELF-ALIGNING!** Bearing unit, with seals independent of housing, can align itself in any direction without seal distortion.
3. **PRE-LUBRICATED!** Bearing chamber is filled with proper amount of lubricant before shipment from SealMaster factory.
4. **NO HOUSING WEAR!** Patented locking pin and dimple prevent rotation of outer race in housing. This eliminates housing wear...permits shaft alignment and positions unit for relubrication.
5. **FLOATING RETAINER!** Ball retainer is designed to float on ground inner surface of outer race. Trap lubricant and prevents churning.
6. **HOUSING DESIGN!** SealMaster's cast housings combine rigid, one-piece construction with smooth streamlined appearance.

*Write for your copy of Catalog 845...gives dimensions and load ratings for pillow blocks, flange units, take-up units, Cartridge units and flange-cartridge units.*

BEARING DIVISION

**STEPHEN S-A ADAMSON MFG. CO.**

47 RIDGEWAY AVENUE, AURORA, ILLINOIS · LOS ANGELES, CALIF. ★ BELLEVILLE, ONT.

*Factory Representatives and Dealers in All Principal Cities*

No. 2A Radiator Vacuum Valve, Adjustable Port

# TIME TO HOFFMANIZE!

## ... AND TAKE A PROFIT ON SLUGGISH RADIATORS

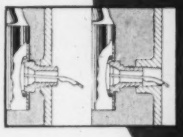
## HAVE THESE VALVES IN YOUR STOCK FOR THE EARLY REPLACEMENT JOBS

**ADJUSTABLE VENT PORT**

Comparative tests show the Hoffman vent port adjustment to provide a smoothly graduated rate of venting in direct proportion to the size of the opening. Adjustable to prevent waterlogging, spitting and rumbling caused by too fast venting.

**NEW, IMPROVED HINGED TONGUE**

Diagrams show how Hoffman Double-Capillary action, hinged drainage Tongue construction adapts itself to radiators equipped with various boss lengths. It assures good drainage under all conditions of service. An exclusive Hoffman feature.



Again it's time to modernize millions of air-bound, stubborn radiators and harvest quick profits on a turnover of Hoffman Vent Valves. For, *in guarding comfort and fuel,* the first step is proper venting . . . a function Hoffman Valves are famous for, backed by nearly forty years of specialized experience, exclusive features and precision workmanship. There is a Hoffman Valve for every need—radiators, convectors, unit heaters, main vent valves for steam and hot water heating systems.

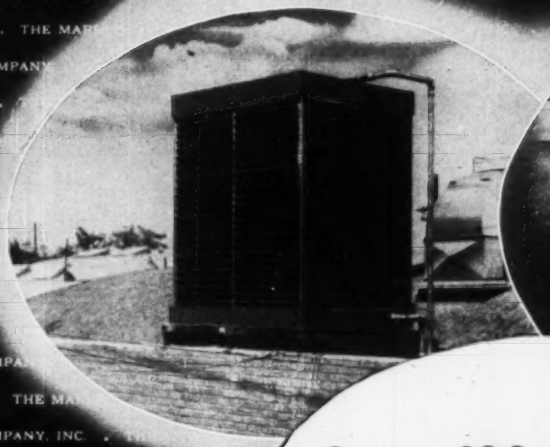
The heating season is right ahead . . . it's time to order the Hoffman Valves you'll need for early modernizing jobs. For complete information on Hoffman Radiator and Main Vents, contact your wholesaler, or write

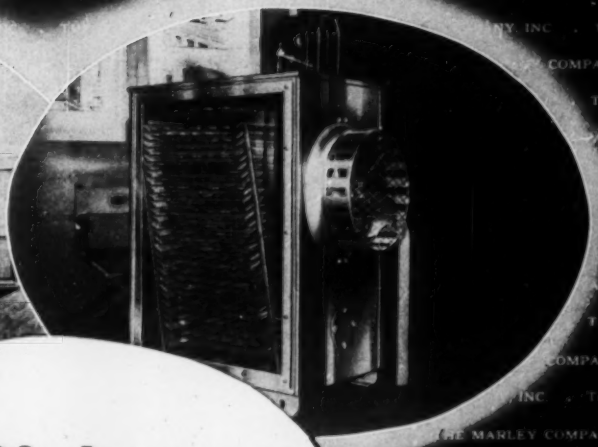
**HOFFMAN SPECIALTY COMPANY • 1001 York St., Dept. FG-7, Indianapolis 7, Ind.**

Makers of Valves, Traps, Hot Water Heating Systems, Vacuum and Condensation Pumps... Sold by Leading Wholesalers of Heating and Plumbing Equipment

# HOFFMAN VENT VALVES

*Controlled Heating*





# Series 100 - Aquatower

## *"A One-Two Punch.."*

## ...to solve any 3 to 50 ton water cooling problem

NO WATER cooling problem in the 3 to 50 ton range is too tough for this proven "Marley team." Either the mechanical-draft Aquatower or the natural-draft Series 100 will meet your specifications . . . no matter whether your problem is low first cost, low operating cost, unusual performance requirements or pumping problems. Nor is location a problem, as one of these two units can be placed anywhere . . . roof, basement, attic, outdoors, elevated grillage, or even suspended from the ceiling. These two towers, both ready for immediate shipment, make up a "one-two punch" that can whip any water cooling problem in this range.

The AQUATOWER (cutaway view shown), a packaged steel cooling tower, completely assembled, ready-to-go. Open pan water distribution basin which is especially desirable for serving multiple air conditioning units. Interior coated with rubber to resist corrosion. Deep pitch, slow speed, quiet fan. Packed from top-to-bottom with heart quality redwood filling. Grease-packed ball bearings. Weatherproof motor. Request Bulletin AQ-50 for dimensions and ratings.

The SERIES 100 . . . a natural draft, all heart quality redwood tower, completely prefabricated and piece-marked for quick field erection. All bolted construction. Balanced spray system with Marley patented nozzles. Basin complete with fixtures—sump and float valve. Request Bulletin 100-50 for dimensions and ratings.

And that's not all of the one-two punch . . . these towers may be purchased on a combined discount schedule on Marley's Merchandising Plan. Your nearest Marley Application Engineer will be glad to explain this plan and show you how the Aquatower and Series 100 will solve economically any water cooling problem.

**MAIL THIS COUPON TODAY**

The Marley Company, Inc., Kansas City 15, Kansas

Please send me without cost or other obligation:

☐ Aquatower Bulletin AQ-50 ☐ Series 100 Bulletin 100-50

☐ Bring me up to date on Marley's new merchandising plan.

HP-7

Name_____ Title_____

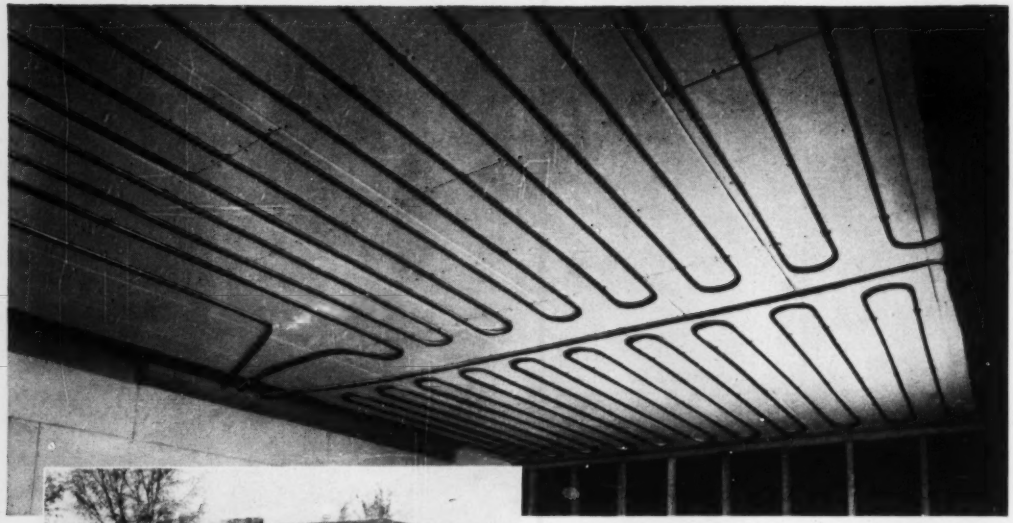
Company Name_____

Address_____

City_____ Zone_____ State_____

MARLEY

Double-Flow Vairflo DriCooler Natural Draft Counter-Flow Aquatower Spray Nozzles



**The best of everything** is in this new home of Mr. & Mrs. Richard E. Larimer of Fort Wayne, Ind., including Bundyweld Tubing for the radiant heating systems in the first-floor ceiling and concrete basement floor. Installation by H. B. Shank & Sons, Fort Wayne, Ind.

# Ideal radiant heating for the ideal home with Bundyweld Tubing

**Yes . . . ideal,** however you look at it.

For Bundyweld is the only tubing *double-walled from a single strip*, a patented construction that gives it advantages no other tubing can match—on the building site or in the heating system.

It's extra-rugged, extra-strong . . . won't dent, crush, twist or sag. No kid gloves needed with Bundyweld! It's lightweight and ductile, too . . . quickly fabricated, easily handled in installation. It bends more readily and takes more bends without weakening structurally. *And your over-all savings in cost are something you'd have to see to believe!*

Bundyweld grids last a housetime. Copper-bonded through 360° of wall contact, this unique tubing is leakproof, *proved by test* . . . no corrosion, no plaster leaks once it's in place. And its thinner, stronger walls assure maximum heat conductivity always.

Get all the latest information on amazing Bundyweld Tubing in the new Radiant Heating Brochure. Write to: ***Bundy Tubing Company, Detroit 14, Michigan.***

# Bundyweld® Tubing

**DOUBLE-WALLED FROM A SINGLE STRIP**

**WHY BUNDYWELD IS BETTER TUBING**

**Bundyweld starts as a single strip of basic metal, coated with a bonding metal. Then it's . . .**

**continuously rolled twice around laterally into a tube of uniform thickness, and**

**passed through a furnace. Bonding metal fuses with basic metal, presto—**

**Bundyweld . . . double-walled and brazed through 360° of wall contact.**

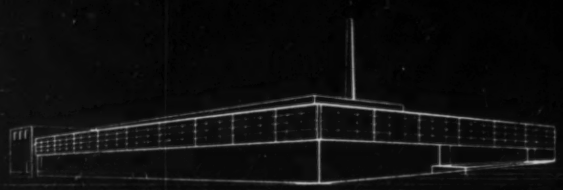
**NOTE** the exclusive patented Bundyweld beveled edge, which affords a smoother joint, absence of bead and less chance for any breakage.

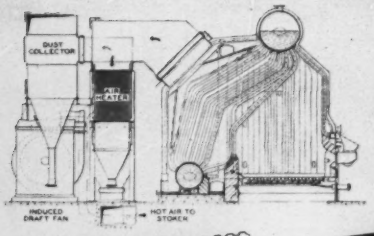
SALL MOUNTAIN COMPANY
Asbestos
UTILITY SERVICE ECONOMY

SINCE the year 1886, when Sall Mountain Company was founded, this company has taken a leading position in manufacturing Asbestos Products and in the fitting of asbestos to an ever widening field of industrial uses.

The latest in advance equipment is of course, important, but most important is the long years of Sal-Mo experience in solving problems involving the use of Asbestos.

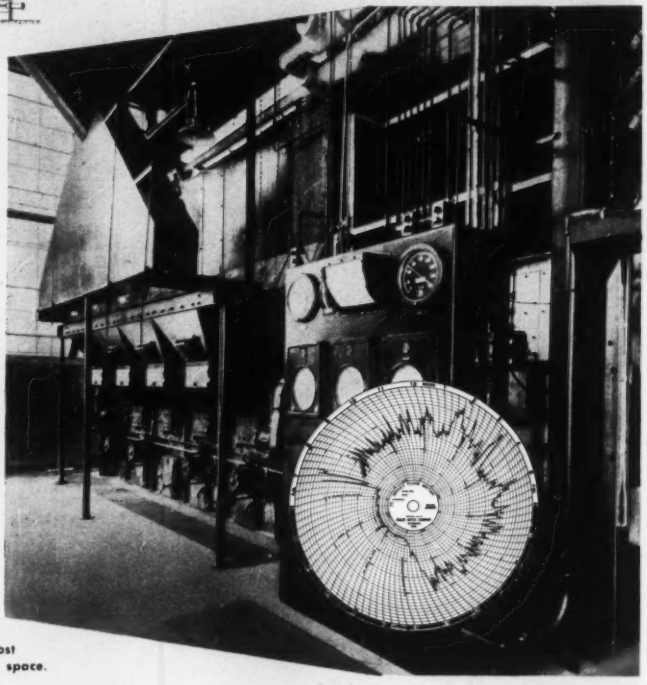
SALL MOUNTAIN COMPANY
ANdover 3-2414 • 176 W. Adams St. • Chicago 3






B&W Integral-Furnace Boiler, Type FF, at Hanes Dye and Finishing Company. Steam capacity is 40,000 lb. per hr. at 125 psi, with provision for future operation at 250 psi and with the addition of a superheater.

*Another Example of B&W Engineering for Economy*



**. . . 20% more steam**

**. . . 37% less space**

**. . . 20% fuel saving**

Compact, single-level arrangement of boiler and auxiliary equipment with one-point control, provides utmost accessibility and ease of operation in minimum space.

Hanes Dye and Finishing Company, Winston-Salem, N. C., recently installed a single spreader-stoker-fired B&W Integral-Furnace Boiler, Type FF . . . in 37% less floor-space than was occupied by four existing units having 1/5 less total capacity. High efficiency is maintained over a wide range of coals, including low grades, resulting in estimated fuel savings of 20%. Operating over a daily load range of 12 to 1, the new boiler easily handles instantaneous load swings of 5 to 1 with close control of pressure and steady water level, as compared to pressure drops as much as 40 psi in the old units. Heavy maintenance costs experienced with the previous installation have been eliminated.

Dollars and cents benefits usually follow B&W's participation in boiler modernization for *any* type of plant. It will pay you, as it has so many other industrial, commercial, and institutional users, to investigate the modern B&W Integral-Furnace Boiler, Type FF, for steam capacities up to 60,000 lb. per hr. Start by writing for Bulletin G-64. The Babcock & Wilcox Company, 85 Liberty Street, New York 6, New York.

B&W

**BABCOCK & WILCOX**

G-461

# THE EDITOR'S PAGES

COUPLE OF MONTHS ago or so we made a crack or two in these pages about the Englishman's sense of humor as reflected by the number of puns appearing in the advertising columns of one of our contemporaries published on the other side of the Atlantic. We've heard from one of our British subscribers, who says he's always hated puns himself, pointing out a few examples in our own columns. He also said our lack of knowledge of the English language was appalling, but saved our day by saying he held our magazine in high esteem. . . . In a succeeding issue, we printed some ill-tempered remarks about the lack of legibility of drawings and charts shown on the screen at too many engineering meetings. We've been thanked for that item by readers who have been fellow-sufferers at such meetings. . . . While we know that many a newspaper columnist has made a reputation for himself by being ill-tempered in print day after day, we're swearing off for this month at least. Must be feeling better.

## RENTS AIR CONDITIONING TO BUILDING TENANTS

LAST FALL, the Professional Building Corp., Washington, D. C., announced to its tenants an arrangement for providing individual room air conditioning units on a monthly rental basis. Billings, on either a monthly or a single annual charge basis, were not to commence until May 1, but tenants were requested to advise of their requirements immediately to enable off-season bulk purchase and installation of the equipment by the building.

The rental includes installation, maintenance, electric current, repairs and wiring to the extent necessary, flat monthly charges depending on the capacity of the unit being announced to all the tenants. At the rate charged by the building, the increase to a tenant in his rent amounts to about 30c per sq ft. The units remain the property of the building.

There was little demand for the equipment from the tenants last fall, but as the weather grew warmer this spring, more calls were received nearly every day. The building was about 50 percent air conditioned by the middle of May.

### "QUOTE"

"Department store owners and operators have found that air conditioning not only increases business and betters working conditions for store employees in basement and first floor sales areas but also year-round air conditioning can well be justified throughout the building to provide filtered, clean air to the store, reducing stock spoilage and building renovation, painting and cleaning costs."—JOHN R. HERTZLER, vice president, York Corp.

## CRERAR OFFERS LIBRARY RESEARCH SERVICE

A "RESEARCH information service" for industrial firms, consulting engineers, contractors, and other technical men is now offered by the John Crerar Library, 86 E. Randolph St., Chicago 1—"the world's largest free public library devoted exclusively to science, technology and medicine."

The scientists and engineers on the RIS staff are well qualified to undertake library research projects for anyone. The 230 projects completed to date include radiant heating, solar heating, infra-red reflections from structures, and the heat pump.

Numerous complete translations of foreign language articles and also extensive summary abstracts of foreign language articles have been done. Patent searches as such are not made but "prior art" searches of the literature are often very important in establishing the validity of a patent or determining whether or not some idea is patentable.

The cost of the service is gaged by time and labor, plus a small percentage to cover overhead and supplies. A brochure, For Economy in Research, has recently been revised to describe the service more fully and is available on request.

## CONSTRUCTORS GROUP OPPOSES SEPARATE BIDS

THE NATIONAL Constructors Association, composed of 20 of the nation's builders of oil refineries, steel mills and chemical plants, has announced its intention at an executive committee meeting to resist efforts of groups within the construction industry promoting the passage of legislation that would require submission of separate bids, directly to the owner, on piping, electrical and other specialty work.

In a unanimous resolution, the association declared that "the passage of such laws would destroy the rights of owners and contracting authorities to freedom of choice in determining the most effective and economical method of accomplishing their construction work."

## CONDITIONERS CONTROL MUSHROOM GROWTH

AN EXAMPLE of the successful use of packaged air conditioners for commercial purposes is found in an installation for the Ohio Mushroom Co., Lima, Ohio, where two 10 ton self-contained air conditioners and a 20 ton evaporative condenser were installed by the Komminsk Refrigeration Co., according to Arthur H. Farr, of Typhoon Air Conditioning Co., Inc.

The rate of growth of mushrooms is extremely dependent upon temperature. For example, the commercial variety grows from a tiny button to a full size mushroom in 22 days at 50 F, 10 days at 60 F, and six days at 70 F. Thus, commercial mushroom culture is almost a controlled industrial process.

The accepted cultural method of growing mushrooms is intricate and precise. Fertilizer is composted or partially decomposed, and then placed in beds about 5 in. deep where it is allowed to generate heat for several days. The house is then cooled down and the propagative material called spawn is planted about 1 ft apart in the beds. After about two weeks, the beds are cov-

ered with an inch of rich soil. About six weeks from the time of planting the mushrooms begin to appear and harvesting continues for about six months. The beds are then emptied and the entire process is repeated.

At the Ohio Mushroom Co., a 10 ton conditioner is used for each set of two rooms. Four branch ducts from each unit run along the ceiling, so that the cooled air will settle slowly toward the bottom of the room. Mushroom beds, 5½ ft wide and 72 ft long, are stacked seven high to a height of about 14 ft. There are 14 beds per room, and the room is 16 ft high. The average mushroom harvest is figured at approximately 1¾ lb per sq ft of bed surface during the harvest cycle.

There are three distinct stages of temperature inside the mushroom house.

1) After the beds are first filled with fertilizer, which generates considerable heat, the bed temperature runs between 120 and 140 F. The fertilizer loses moisture during this period and consequently the room becomes very humid.

2) During the second period, after the spawn has been planted in the beds, a moderate temperature of 65 to 75 F with high humidity is required.

3) The third period, when the mushrooms are developing on the beds, is the most critical of all. Bed temperatures of 58 to 60 F are required, with moderate humidity.

Carl H. Komminsk, who installed the equipment, claims that the most important single feature of this job is the zone control principle. "For example," he says, "if scattered clouds should produce a fluctuating heat load on the south wall, a packaged unit on the south side will automatically adjust for the varying temperatures, and the others will not be affected."

## ROCK ISLAND COMMUTERS ENJOY AIR CONDITIONING

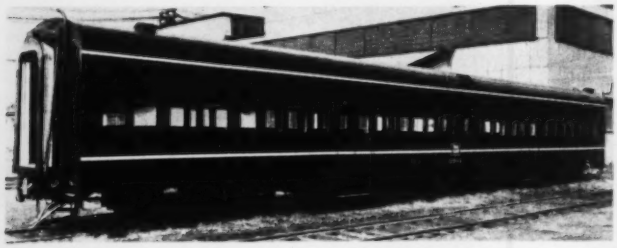
COMMUTERS ON the Rock Island's suburban service between Chicago, Joliet and intermediate stations keep an eye out these hot summer days for seats in 12 of 20 new streamlined cars put in service earlier this year—the 12 are air conditioned, and the others have forced, filtered air ventilation.

The cooling unit is overhead in the center of the car, comprises a 10 ton evaporator with two blowers furnishing a total of 1500 cfm each way from the unit which is delivered through perforated panels forming the bottom of the full-length duct.

About 25 percent of the air is from outside and the rest is recirculated. Both outdoor and recirculated air passes through oil-impregnated, metallic filters.

Seating capacity is 100. Entrances to the cars are provided by two sets of pneumatic controlled sliding doors on each side of the car instead of the conventional vestibules at the ends. They are equipped with fluorescent lighting, shatterproof, double pane insulating windows and thermostat controlled heating. Trains assigned to the longer suburban runs have washroom and toilet facilities.

**One of the Rock Island's new suburban cars, 12 of which are air conditioned. The road is credited with placing in service the nation's first diesel powered and completely streamlined suburban service**



## NEW ORDERS BOOKED SET A RECORD

NET PROFIT OF Carrier Corp. (air conditioning, refrigeration and industrial heating) for the 12 months ended April 30, 1950, was $1,099,046, or $1.47 per common share, as compared with $2,083,320, or $3.14 per common share, for the preceding similar period. Completed business totaled $44,358,536. The comparable figure for the 12 months ended April 30, 1949, was $51,198,786.

New orders were booked in the amount of $49,603,083. The total for the preceding 12 months was $48,634,081.

On April 30, 1950, the corporation had a backlog of unfilled orders amounting to $26,180,781, as compared with $20,174,779 a year earlier. These figures are exclusive of a sizable government contract obtained in fiscal 1949 under which deliveries are expected to be made in substantial volume during coming months.

According to Cloud Wampler, president, business completed during the six months ended April 30, 1950, was materially below expectations because of production delays resulting in part from the steel and coal strikes. However, new orders were booked at a very satisfactory rate, and the total for this period set a new high record for the first half of the corporation's fiscal year.

## INSTALLED COST OF SNOW MELTING SYSTEMS

APPROXIMATELY $2.50 per square foot of sidewalk was the cost of the snow melting systems at 100 Park Ave. and at the Mutual Life building, both of which are in New York City, according to Alfred L. Jaros, Jr., of Jaros, Baum & Bolles the consulting engineers in each case. The systems were installed by different contractors.

The figure given represents the cost of the complete *mechanical* system—coils, piping, pumps and heat exchangers, valves and controls, initial charge of antifreeze, etc.—but does not include any of the construction costs for the sidewalk slab and finish, insulation, reinforcing, etc.

A brief description of these two snow melting projects was given on page 81 of the June Heating, Piping & Air Conditioning.

Equitable Building, 120 Broadway, New York. Architect: Ernest R. Graham. Heating and General Contractors for original installation: Thompson-Starrett Co., Inc. Heating Modernization, Consulting Engineers: Franklin J. Leerburger and Joseph R. Weiss. Contractor: Carl E. Joecks. Webster 522 Sylphon Traps (shown in outline) originally installed in the Equitable Building in 1914. Modernized in 1949 with Webster Replacement Thermostatic Assemblies (as shown).

# STAR PERFORMERS on Broadway for 35 years

Webster Sylphon Traps, after an unbroken run of 35 years in the famous Equitable Building, 120 Broadway, are continuing regular every-season performance as vital parts of a modern Webster Moderator System of Steam Heating.

There were 4,800 No. 522 Webster Sylphon Traps installed in the Equitable Building in 1914 as part of the original Webster Vacuum System of Steam Heating. In 1949, after 35 years of service, every trap was inspected as part of a heating modernization program and it was found that many of them were still giving *new trap results*. The balance were renewed with Webster Thermostatic Assemblies screwed into original traps without disturbing the piping.

## THE NEXT 35 YEARS

In 1949, it was decided to remove the steam and electrical generating installation, freeing valuable space, and to substitute purchased electricity and steam. After checking with 50 leaders in the building management field in New York, the owners of the Equitable Building decided to convert their installation to a Webster Moderator System of Steam Heating. With this System, radiators are always warm. The amount of steam delivered to the radiators is varied automatically through the operation of a Webster Outdoor Thermostat.

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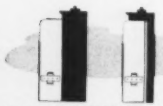

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Do YOU HAVE something you'd like to say about any of the articles published this month? An additional comment, or perhaps a question on some point? Or do you want to express your views on some other matter of interest to heating, piping and air conditioning engineers or contractors? We follow here the custom at engineering society meetings of providing an opportunity for discussion following presentation of a paper. You are invited to participate. Just address your remarks to the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.

## DEHUMIDIFYING AIR FOR DRY BLAST

THERE ARE TWO points to the controversy about dehumidifying air for dry blast in steel production which was mentioned by John Everetts, Jr., in his recent ASME paper on the subject abstracted in the May issue of HPAC. It may be helpful to air conditioning people to amplify them.

The first point is to what dew point should the blast be dried, and the second is what results in the way of increased output and in fuel economy are to be expected? Both involve many variables, but the singling out of a few should provide a perspective of the problem and, what is more important, throw light upon the danger of predicting or promising results—either directly or by inference.

Whether the moisture content of the blast should be 3, 2 or 1 grain per cu ft hinges broadly upon the kind of iron that the furnace is making, and upon what might be called the "philosophy" of the practice that is applied. Silvery iron, ferro-manganese and others which have a very high silicon content, require the highest furnace temperatures. Basic or mill iron is made with the lowest furnace temperatures; foundry iron with intermediate temperatures. With the higher furnace temperatures, low moisture content in the blast provides the greatest opportunity for saving fuel.

As to the philosophy of practice, many furnace operators are strongly influenced by the value of "regularity" and the law of diminishing returns. It not only costs more to take out each successive grain of moisture as the dew point goes down, but in addition each successive grain will save less fuel and will have less influence upon smoothness of operation. Some operators believe that, below a three grain dew point, the effect of variations in moisture content is not worth the cost of avoiding them. Others add moisture during the winter months to bring the blast up to three grains on the basis that the benefits of regularity offset the fuel savings which might otherwise be obtained.

As to forecasting results to be expected in any particular case, either by inference or by direct statement, there are several points to be considered. What has been gotten out of one furnace does not, by any means, prove that the next furnace will respond. Blast furnaces are notoriously temperamental. It's a well-known fact that two furnaces built at the same time, from the same blueprints, and making the same iron out of the same raw materials, will have distinctly different operating characteristics. There seems to be no explanation for this, but it remains a fact.

Good results do not ensue when dry blast is applied. In fact, the sudden start-up of a dry blast system can throw a furnace into rough operation and cost thousands of dollars in lost production (about $15,000 per 24 hr) or in off-grade iron. The only "no man's land" into which air conditioning people can safely step, is an insistence that the moisture content of the blast be brought down slowly—not suddenly. The elimination of sudden changes is one of the greatest values of dry blast.

The burden (of ore and limestone on fuel) is set when these materials are dropped through the bell at the top of the furnace. It takes this mixture some 8 to 10 hr or more to travel down through the stack into the critical zone. At that point, sudden decreases in moisture will cause sudden rises in furnace temperature—and increases in silicon content. Such rises can be offset to some degree by reductions in blast (air) temperature. The reverse can be done provided a sufficient amount of stove heat has been held in reserve.

In driving a furnace to get the full benefit of dry blast, risks must be taken. Whatever reserve capacity might be in the stoves must be applied to production. If under such circumstances, the dry blast plant fails and lets the furnace superintendent down, he is deep in trouble.

In spite of advances in science, iron making is still very much of an art, and the responsibility of driving a furnace is an exceedingly heavy one.

Therefore, the most important feature of a dry blast plant is not to what moisture content it will dry to—not whether one kind of air conditioning is more efficient than another—but a simple matter of reliability and dependability. If results are to be had from dry blast, the furnace operating crew, from the blast furnace superintendent on down, must have a complete and abiding faith in the dependability of the plant. If that kind of reliability is not designed into and built into the dry blast plant, the operating crew cannot be expected to apply the kind of courage that it takes—a kind that demands respect. —L. L. LEWIS, vice president, Carrier Corp.

## WATER TREATMENT FOR COOLING TOWERS

JOHN B. DAVIS has handled a difficult subject very well, in his article on Water Treatment for Cooling Towers, published in the April HPAC. I particularly like the man-

ner in which he avoids "cure-alls."

There are a few comments I would like to make on technicalities contained in his paper. Referring to the fourth paragraph under the subhead Cooling System Problems, corrosion from ammonia developing from bacterial metabolism seems an extremely remote possibility. I would not expect ammonia to be corrosive to iron even if present, and if corrosion occurred with copper or copper alloys the corrosion products would probably kill the bacterial growths.

The first paragraph under the subhead Characteristics of Deposits is somewhat of an over-simplification of an explanation for the presence of calcium in natural water supplies. Sometimes an explanation of the relationships of solubilities of bicarbonate and carbonates and carbon dioxide and what happens with change of temperature helps to give the layman a better understanding of why scale forms. Referring to the last paragraph of this section, I would ask the source of the soluble iron. Did it come with the supply water or from corrosion of the system?

As to chlorination, I would suggest explanation of different types of killing action; that is, actual oxidation and destruction of growth versus toxic surface killing effect.—RALPH M. WESTCOTT, Pomeroy & Westcott, engineers and chemists.

## OBJECT OF HEATING TO PREVENT EXCESS LOSS

THE ARTICLE by F. W. Hutchinson in the December HPAC was interesting academically and no doubt correct mathematically. Practicing heating engineers, however, will recognize that certain fundamental concepts of heating have been overlooked. My remarks are not intended as a defense of the layman's concept of an "indoor sun" by radiant heating or by any other method of heating, but are intended to point out that the assumption that heating is accomplished by supplying heat to the body is erroneous. Only in rare cases, mostly medico-therapeutic, is this actually accomplished. Calculations based on this assumption must, therefore, also be erroneous.

In discussing the amount of heat transferred from the panel to the body, the word "received" has been used. This is an unfortunate choice, as "intercepted" is the more correct term. Use of the word "received" is, in effect, subscribing to the old fallacy that heating is done for the purpose of *supplying* heat to the body. This is not true. The purpose of heating is to *prevent heat loss* from the body *in excess of normal*.

In an average ambient condition the body feels comfortable, and is losing heat at the rate of about 450 Btu per hr, total sensible and latent. Increasing or decreasing the ambient air conditions decreases or increases the heat loss from the body, resulting in a "warm" sense or a "cool" sense, respectively. Carried to extreme this may cause actual physical damage to the body.

Assume a condition of raised ambient temperatures, say in a room at 75 F dry bulb. The occupant will feel "warm" and moves closer to a cold surface, such as a large window, where he will again feel comfortable. The air temperature is still 75 F, but he is losing radiation to the cold glass in excess of normal, so that the average heat loss from his body totals his normal Btu per hr. This is an example of radiant cooling.

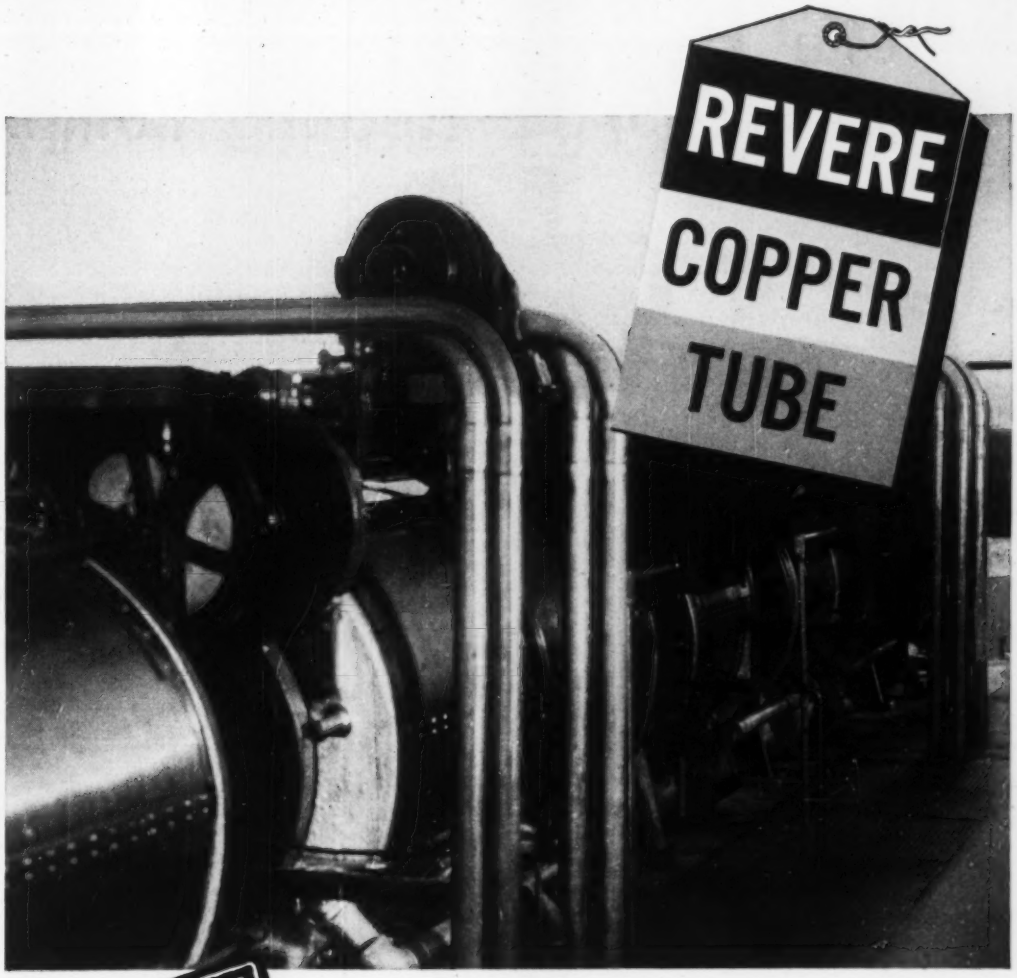
On the other hand, assume a condition of lowered ambient, say 65 F. The occupant will feel "cool", unless he finds some warm object, in order to decrease his heat loss back to the average rate. In a radiantly heated room, all the room surfaces are warm, and will offset the 65 F air temperature which is common in radiant heat installations. This condition is carried to the extreme in the "open air" hospitals and classrooms where air is not heated at all. The radiant heating panels *are not*, however, *supplying* heat to the occupant. They are offsetting the heat loss from his body to any surfaces colder than his own, and his being in the room at the time is purely coincidental. He is *intercepting* heat rays from the panels to the cold surfaces, and actually upsetting the pure mathematical relationships between the warm and cold panels.

In any radiantly heated space, a certain percentage of the heating effect will be by true radiation and the balance by convection to the air. These convection currents will in turn assist in warming all other objects in the room to, or near, the air temperature. In addition, all objects including furniture, walls and ceiling (in the case of a floor panel), will receive radiation from the panel. By the use of the usual radiation equations it can be shown that the walls and ceiling of a 20 x 20 x 8 ft room will reach a temperature determined by their absorptivity. Since absorptivity and emissivity are equal and opposite, these areas can be shown to act as secondary radiant panels, whence the formula can be re-used in determining the total amount of radiation intercepted by the occupant. This radiation must be sufficient to offset his excess heat loss to the cold air. Maintain the average heat loss at normal and he will feel comfortable.

It could no doubt be shown that other types of heating systems tend to create a stratum of heated air at the ceiling. This air heats the ceiling by convection, creating a radiating panel. Since the room air at breathing level is at 70 deg, or below the body temperature, any heat which might be "received" by the occupant must be in the form of radiant energy from this secondary heat source.

A ceiling panel operating at a temperature above that of the human body contains, on a small scale, the same heat radiating features of the sun. The vast difference in the computed heat transfer is, of course, due to the differences in the areas and the absolute temperatures involved. A glance at the formula for radiant heat transfer will demonstrate this.

It should, therefore, be evident that in any comfort heating system: (1) All warmed surfaces within a room act as secondary radiant heat sources in the ratio of their absolute temperatures; (2) These surfaces may be warmed by radiation or convection; (3) It is difficult to heat air by radiation because of its absorptivity, therefore any air heating which may be accomplished is done by means of convection; (4) A sense of comfort can be achieved regardless of air temperature, by maintaining average loss from the body at the correct amount; (5) Any heat received or intercepted by occupants is incidental and generally undesirable, and must be offset by equal additional losses.—DONALD P. HOLMES, registered professional engineer.

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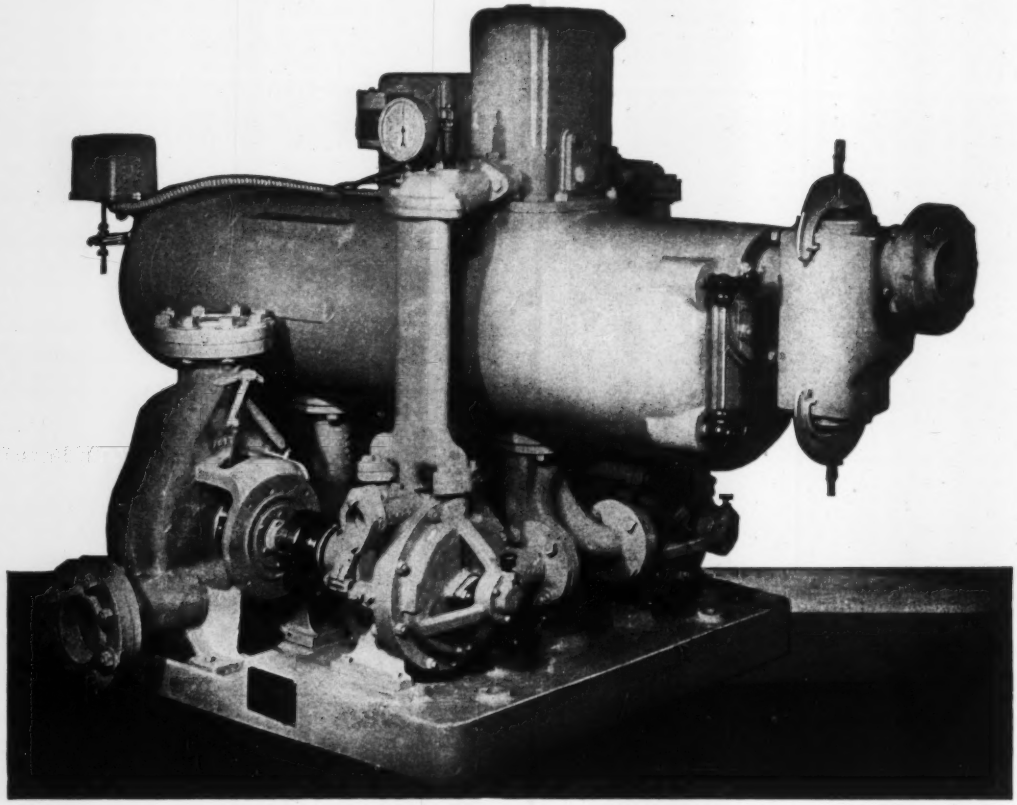

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# Controlling Fume Hood Exhaust in Atomic Energy Laboratories

*HOMER B. CLAY, of the commercial division of Minneapolis-Honeywell Regulator Co., describes the details and applications of a new method of control for fume hood exhaust systems which was developed for the Atomic Energy Commission. The job is to move air across laboratory desks and through a hood at such a rate as to insure positive protection for laboratory workers but slow enough not to disturb the minute particles of matter being worked on. The method is now developed to the point where it may be installed almost universally on low velocity systems of this type*

BECAUSE OF THE unusual hazards to health presented by many materials used in atomic energy work, special consideration must be given to proper regulation of fume hoods and exhaust systems. Such systems virtually comprise a science in themselves, involving the design of the hood or canopy to provide the proper air pattern for collecting all or some part of the contamination from the source, the design and construction of ducts to carry off the materials without excess condensation or concentration of contamination at any point, the collection of contamination before releasing the transport medium, and the design and application of fans and blowers used in creating the proper exhaust air volumes.

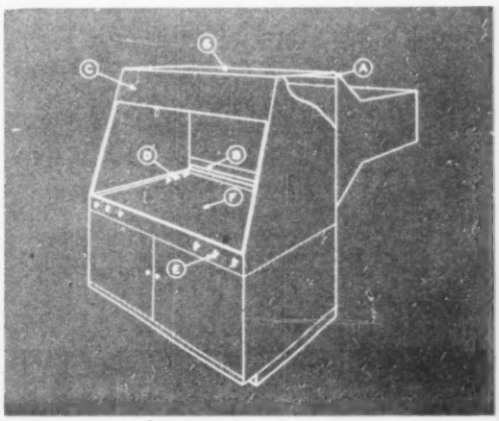
These considerations exist to various extents in atomic energy fume hood work. The possibility of contaminating entire regions with radioactive material is such that the exhaust fumes must be reasonably cleared of these substances before being discharged into the atmosphere. Fortunately, some of the radioactive materials remain dangerous for only a few minutes, so high velocity stack discharges are usually sufficient to remove any hazard incurred from radioactive gases. Elaborate filtering is required of the longer-lived materials before release of the transport medium. Of course, the atmosphere in areas immediately surrounding atomic energy laboratories is carefully monitored for excess radiation. In closely populated areas, continuous meteorological surveys are maintained and if weather conditions are unfavorable for the dispersion of the gases, activity is reduced to a minimum until conditions are more favorable.

Conventional enclosed fume hoods usually consist of a canopy over the work area with three sides dropped down around the bench. Air is exhausted through the top of the hood with sufficient exhaust head maintained to create a suction through all points in the open front of the hood. Naturally, the velocity entering the top edge is likely to be slightly higher than that entering the lower edge, so baffles are often provided to insure exhaust from the work surface itself.

Further refinement of the laboratory type of fume hood has produced the kind of hood shown in Fig. 1. The work area is encased on three sides by the tentlike canopy. Fumes are exhausted through adjustable slots *A* and *B*. Some air must be drawn off the top to take care of light fumes and some off the bottom to take care of heavy smoke or particles. It is important that no dead pockets be allowed to form within the hood in which vapor may condense. The hood is usually made of noncorrosive material and must have airtight seams so that heated gases cannot escape through leaks in the canopy. *C*.

The supply lines for water, gas and air come up through the work surface, *D*. The shafts on the valves or faucets for these services are extended out through the front of the hood, *E*, so that the operator doesn't need to place his hands in the enclosure to make adjustments.

**Fig. 1—Laboratory type of fume hood with the work area enclosed on three sides. Features are described in the text, as indicated by the letters**



The floor of the hood is lowered slightly to form a tray, *F*, so as to confine spillage in the hood as much as possible. It is also customary to furnish the hood with a transparent movable door to permit observation of a process without danger of being splattered. A recessed light is often provided at *G*, but care must be taken that the fixture is also sealed against leakage.

### Exhaust Requirements of Hood

The exhaust requirements are expressed in terms of air velocity to a great extent, and may be stated thus:

1. Air must enter every opening in the hood to insure complete ventilation and at sufficient velocity to carry off fumes and suspended particles which are dangerous to health and equipment.
2. The air velocities must be low enough so as not to disturb the process being conducted within the hood.

Difficulties are often encountered in establishing the exact requirements, and the result is usually a compromise. For example, a bunsen burner flame is difficult to use in air velocities exceeding 100 fpm; at 200 fpm the unscreened flame is useless, and it is extinguished at about 600 fpm. Fine powders are disturbed in the 100-150 fpm region. Delicate measurements require maximum velocities as low as 30 fpm. On the other hand, industrial hygienists have established 65 fpm as the minimum entering velocity for chemical fume hoods, and for most substances at least 100 fpm is required to prevent spillage of fumes out into a laboratory in normal use.

When the minimum and maximum allowable velocities overlap, a velocity as low as absolutely necessary is maintained and extreme caution is practiced in using the hood. For example, a person normally walks with a velocity between 300 and 350 fpm. The eddy currents which build up behind him are sufficient to aspirate fumes from a low velocity hood. Consequently, nobody walks rapidly past a hood under which hazardous materials are being used. One of the keynotes of the health physics departments at the laboratories is to think before making the slightest move, and the educational program has been very effective in keeping accidents to a minimum—even to the extent of preventing the drawing out of fumes from a hood.

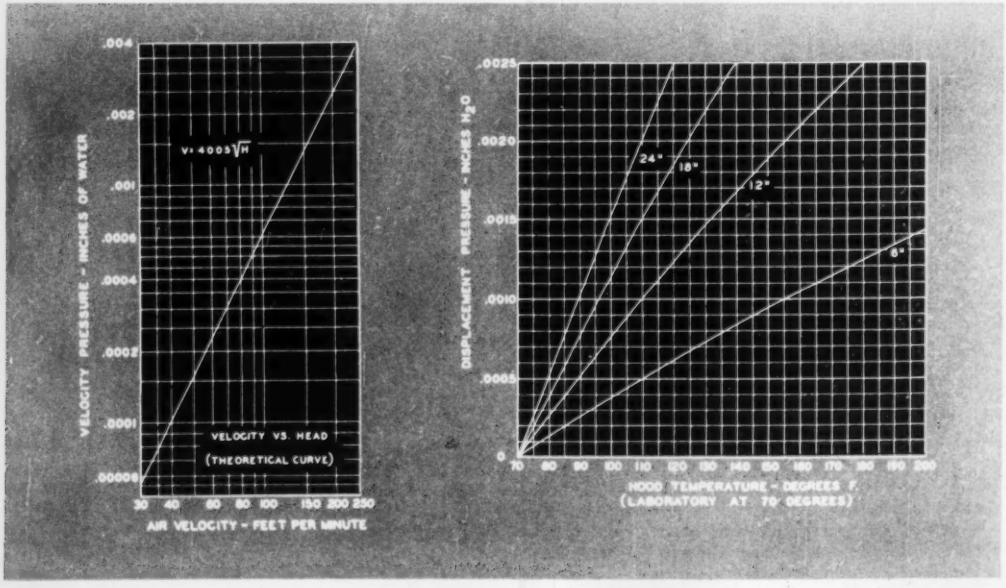
The other extreme in requirements is represented by cooking hoods under which high temperature operations are carried out. The only definite requirement is that a sufficiently high negative head be maintained within the hood to insure complete scavenging of the fumes given off in the operation together with any products of combustion, etc., which might arise from the process. Since precision regulation is not usually required on a "cooking hood," no further consideration will be given this type.

### Duct Design Involves Compromises

The design of the duct system through which exhaust fumes are carried is also a series of compromises. High velocity ducts are usually required for rapid transportation without excessive cooling and condensation, but this kind of duct design provides undesirable friction drops which can vary immensely as the load on the system changes. Large variations in duct friction affect adversely the control results, the ideal system having constant friction at all times—or even an increase in friction as the load drops off.

Since dampers of one kind or another are used to regulate the air volume, consideration should be

**Fig. 2** *(left)*—**Pressures for various velocities, at sea level, based on the formula shown, where *V* is linear velocity of air, fpm, and *H* is static pressure difference, in. of water. Fig. 3** *(right)*—**Pressure heads set up by two columns of air at different temperatures**



given the frictional drop which will have to be taken across the damper—not only at design load but at near-zero conditions. Since the damper can regulate only by increasing or decreasing its friction, the fan must be sized to deliver its full air supply against the highest friction head the system will have. If this is high, however, and the system is controlling by regulating volume only, then this entire drop will appear across the damper when the load has dropped off to nearly nothing. Aggravating the situation, the drop in volume causes the fan static head to pick up a little higher as its operation point moves back on its curve. In plain language, the damper has to pass the most air when the drop across it is minimum, and it has to pass the least when the drop is maximum.

Table 1 shows a set of hypothetical values which might be found in a fume hood exhaust system. An entering air velocity of 100 fpm, which is created by a negative static head within the hood of 0.000624 in. water column, is assumed. The laboratory itself is assumed to be at atmospheric pressure.

It can easily be seen from the table that in order to provide sufficient capacity when the high density filters are dirty, the damper would have to start with a friction drop of 1.3 in., far too much to throttle properly. As the damper throttles down, the friction across the damper increases until at 100 cfm the damper friction must be over 4 in.

With a high static head across the damper, and with the damper tightly closed, the noise created will be uncomfortable unless the system is sealed. Not only that, but as soon as any air at all is required, the damper will have to open slightly, and unless the damper is a precision piece of machinery it will flutter and tend to cycle from fully closed to its first open position. (It should be borne in mind that any volume control system has a certain minimum below which it can no longer provide proportional control). Improving the design of the damper will permit lower minimums, but at the cost of more complexity within the exhaust duct where contamination and corrosion are likely to occur.

A more suitable answer is to lower the capacity of the fan as the load becomes lighter by bypassing atmospheric air through the fan. Then a volume control system might be set up within the individual exhaust duct but linked to the bypass system so that, as the volume damper opens, the bypass damper closes. Systems analogous to this have been frequently used in commercial air conditioning work.

**Table 1—Hypothetical values of friction, in inches of water, which might be found in a fume hood exhaust system**

| Component | Friction at 1000 cfm | At 500 cfm | At 100 cfm |
|---|---|---|---|
| Hood | 0.000624 | 0.000624 | 0.000624 |
| Ductwork | 0.2 | 0.05 | 0.002 |
| Prefilter | 0.5 | 0.154 | 0.01 |
| High Density Filter | | | |
| Clean | 1.5 | 0.462 | 0.03 |
| Dirty | 2.5 | 0.77 | 0.05 |
| Total (Clean Filter) | 2.200624 | 0.666624 | 0.042624 |
| (Dirty Filter) | 3.200624 | 0.974624 | 0.062624 |
| Fan Static Pressure | 3.5 | 4.25 | 4.2 |
| Required Damper Friction | 1.3 to 0.3 | 3.58 to 3.28 | 4.16 to 4.14 |

A second method of handling this problem is to maintain by pressure regulation the static head immediately behind the damper, again controlling the capacity of the fan by a bypass system. The system may then be controlled by a voluhe control system, inasmuch as the damper will be operating against a fairly low constant friction at all times.

A third method which has found favor is to bypass air directly around the hood into the individual exhaust duct, keeping the amount of air handled by the system constant at all times. This has the disadvantage of wasting conditioned laboratory air, if air conditioning equipment is installed, and also of passing through the high density filters air which might need no filtering—with the result that filter life could be unnecessarily shortened.

## Thermal Head a Complication

One factor whose solution helps also to overcome the high damper friction problem is that of thermal head. Whenever any heat is used within the hood, whether in the form of a bunsen burner or only a light bulb, thermal heads can be set up which will completely upset the balance of the system, as will be shown. In order to prevent this build-up of thermal heads, a considerable amount of air is required to enter the hood at all times. Since this minimum air often exceeds half the design total hood exhaust cfm, only half the capacity is actually being regulated, the other half being present at all times in the form of minimum air.

Fume exhaust systems are often designed without consideration given the effects of internal heat sources within the hood. If, for any reason, the internal temperature of the hood is allowed to build up, the hood exhaust system fails of its purpose; for, instead of exhausting all gases from within the hood, it allows some to be blown out into the laboratory atmosphere. The reason for this is simply that the exhaust heads being maintained are so small that the thermal heads created by hot gases within the hood often exceed this pressure, forcing air into the laboratory at a velocity depending on the hood temperature and the height of the opening through which the gases are leaving.

(The height of opening does not imply the lower edge of the door in most hoods; the door may be completely closed. However, if the upper edge of the opening covered by the door is not sealed tightly against the door, a slot is formed through which fumes may escape. Also, if the seams in the canopy are not airtight, fumes may be blown out through these cracks).

Fig. 2 is a curve of pressures required to support various velocities. It holds approximately true for average sea level conditions and is based on the formula shown on the curve, where $V$ = linear velocity of air in feet per minute and $H$ = static pressure difference in inches of water column.

Fig. 3 represents the pressure heads which will be set up by two columns of air at different temperatures. For example, if two columns of air are 12 in. high and at temperatures of 70 F and 155 F respectively, the 70 deg column of air will offset the 155 deg column of air with a pressure of approximately 0.002 in. of water. Such a pressure

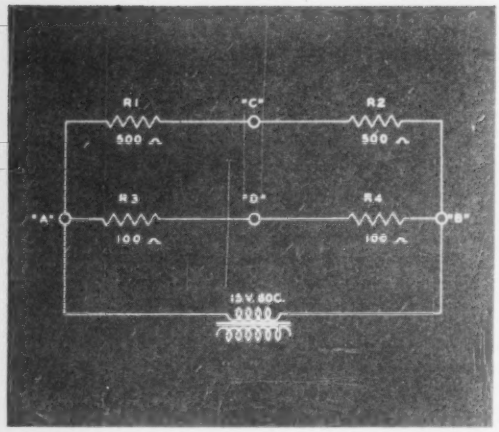


**Fig. 4** *(left)*—**Simple voltage bridge circuit made up of four resistors. Fig. 5** *(right)*—**The sensing element, the small resistance winding being** *R1* **in Fig. 4 and the larger winding** *R2*

difference is sufficient to induce a significant convection velocity.

The air within a hood is not likely to be at uniform temperature. Make-up air entering the hood from the laboratory will provide cool regions along the work area, while the heat building up within the hood will tend to collect and stratify near the top. However, the curves in Fig. 3 give an indication of what happens during stratification. An exhaust static head is being maintained to support 100 fpm. This head is approximately 0.0006 in. of water. If the hood is now heated, so that the air within the hood rises to 155 F, the thermal head will be 0.002 in. of water at 12 in. above the work surface. If the air moving across the work surface is maintained at 100 fpm, the exhaust head is still 0.0006 in. The result will be that air tends to leave any opening 12 in. from the floor of the hood at a velocity representing the difference in pressure between the inside and outside, which would be approximately 0.0014 in. or 150 fpm. If the opening were 24 in. instead of 12 in. from the floor of the hood, air would attempt to leave that opening at a pressure of around 0.004 in. minus 0.0006 in., a resultant pressure of 0.0034 in., or a velocity of 230 fpm.*

Again, it should be emphasized that this is not a true picture of what happens within the hood. Actually, as mentioned before, the hot gases build up near the top of the hood. Therefore, actual observations of air movement will show that air enters the hood at all points from the floor of the hood up to a level a few inches below the upper edge.

At the upper edge, the hot gases force themselves out into the laboratory with considerable velocity and begin to rise. A small amount of this "spillage" is drawn back into the hood, but most of it escapes and disperses into the laboratory air. The highest escape velocities are found near the top. An open seam or a leak around a light fixture will usually permit a strong jet of exhaust gases to be blown into the laboratory. Eliminating this difficulty is sometimes an involved process. A system might require a 100 fpm control velocity while the hood is cold. When heat is added, the control velocity may still be maintained in the lower regions of the hood; however, fumes will escape from the upper regions. If the velocity is raised so that fumes no longer leave the upper area of the hood, the velocities over the work surface will be excessive.

If the old methods of hood design were adhered to, in which the hood was exhausted through the top, this problem would disappear provided sufficient make-up air were being supplied to the hood to prevent too much of a temperature build-up within the hood. But in order to draw off the more dense gases and particles, exhaust must be maintained along the lower edge as well as at the top edge.

Averaging the control point from several levels is useless because it is still possible to set up a condition under which the velocity at the top will be too low and that at the bottom will be too high. Instead, separate control might be maintained through the top and bottom slots, but such an arrangement would be costly and inefficient. The two control systems would likely hunt, as each correction from one would affect the operation of the other.

The simplest way to alleviate the difficulty is to adjust the upper exhaust slot to remove more air when heat is to be used in the hood and then to prevent the build-up of temperature within the hood by bringing in a large amount of laboratory air. This will dissipate the heat and prevent stratification. Stratification occurs usually when the hood door is near its closed position. Under this condition, the system removes many of the fumes, but with insufficient make-up air entering the hood, the gases become hotter and hotter until high thermal heads force them out.

## Regulating Fume Hood Exhaust Systems

Laboratory fume hood exhaust systems usually require some form of regulation. Many means of accomplishing this have been devised.

If the uniformity of the exhaust static head and laboratory pressure can be relied on, a manually set damper is sufficient for short intervals of time. The face velocity may be measured and the dampers adjusted so that it reaches the

*The theoretical background for this analysis of the heat phenomena was presented by Charles S. Leopold at the Los Alamos Scientific Laboratories.

proper level. Then, as long as conditions remain unchanged, the velocity will remain constant. However if a door is provided on the hood, as is usually the case, changing the door position will change the velocity. Because little of the total drop in the system is being taken up across the large hood opening, there will be little change in air volume as that opening is varied; instead, the velocity will change. Closing the door halfway will almost double the velocity. The increased entering velocity will produce a far more pronounced vena contracta, resulting in velocities at some points actually exceeding twice the original velocity. Unfortunately, these points are usually along the edges of the opening; if any light objects are near the front of the work area, they are likely to be swept back or at least disturbed.

One answer to this problem which has been used with varying success is a mechanical linkage to the damper system from the door. As the door opens, the damper system permits more air to enter the hood. Usually the linkage is arranged so that as the door is opened a face damper is opened, allowing more air through the hood, and at the same time a bypass damper is closed slightly. This preserves the advantage of having constant air flow through the greater part of the system, resulting in a fairly uniform pressure drop at the controlling damper. Again, such a system will provide uniform velocities over short periods of time.

Other variables enter into the problem which have not yet been accounted for. For example, if the hood is set with a medium door opening and with a person standing in front of it, the velocity through the face of the hood will fall off if the person moves away. If several persons were to move up quite close to the door, the velocity would increase slightly. If large barriers or other objects are placed in the hood they will also interfere with the low velocity air flow pattern being maintained. Likewise, any variations in supply air static pressure influence air velocity.

Most important of all is the fact that there is nothing actually detecting the presence of air movement. If a filter should stop up completely—and this is not uncommon—no air at all will be drawn through the hood and the fumes will be allowed to drift freely into the laboratory. The opposite result would be less serious; if a filter should blow out, the velocity will rise considerably, and although a particular process may be ruined there should be no danger to the operator. In actual practice, the filters gradually become dirtier and dirtier, with the result that the friction drop builds up gradually.

A manual system must therefore be readjusted at intervals with continuous monitoring to insure that sufficient velocity is being maintained. These intervals may be quite frequent (possibly every hour or so) or they may be days apart, depending on the type of work being carried on within the hood and the materials being released through the exhaust system.

Unless the velocity is actually being measured, either in the form of a negative static pressure within the hood or as a measurement of the air movement itself, there is no guarantee that any air will flow nor any warning if it ceases.

Ideally, some method of constant measurement of air movement should be used. This measuring device may be used merely to operate an alarm if the velocity falls outside the specified limits, or to control the damper system so as to maintain the velocity within these limits. Accurate detection requires that the static head or velocity be measured within the hood itself. Then all other variables in the system are taken care of automatically—such as changes in static head due to large load changes in other branches of the main exhaust, changes in filter characteristics, changes in atmospheric conditions around the exhaust stack, or any other variables which might influence the air volume.

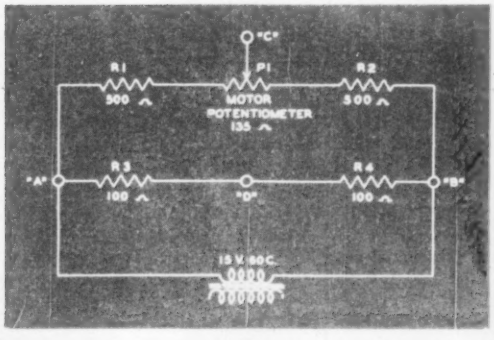
A static pressure regulator may be used to detect these changes if the velocity is high enough. However, at the velocities normally required, 30 to 100 fpm, the static pressure is so low that it is difficult to maintain static heads accurately. These pressures range from 0.000056 in. up to 0.000624 in. (Fig. 2).

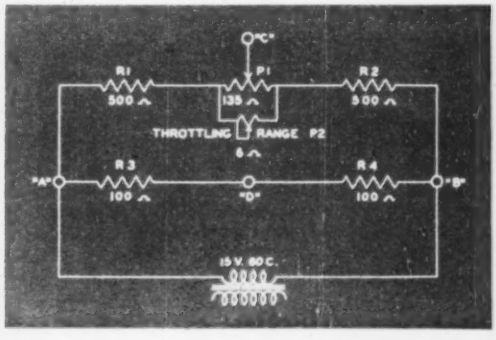
## Measuring Low Velocities for Control

In order to measure these low velocities, a new kind of regulator has been developed, utilizing the cooling effect of air movement over a heated surface. Its operation is quite simple, involving only the use of bridge circuits common to proportional control.

Fig. 4 shows a simple voltage bridge circuit made up of four resistors. *R1* and *R2* are 500 ohms each, and *R3* and *R4* are 100 ohms

**Fig. 6 *(left)*—More complete bridge circuit, with a motor follow-up potentiometer wired into the circuit to achieve proportioning control. Fig. 7 *(right)*—A second variable resistor, *P2*, is added to make the throttling range of the system adjustable**



each. A transformer supplies 15 volt alternating current across these two branches at points *A* and *B*. The centers of the branches are marked *C* and *D*. Since the voltage at both *C* and *D* will be $7\frac{1}{2}$ when measured with respect to either *A* or *B*, zero voltage difference exists between *C* and *D*.

Should resistor *R2* increase in value slightly, the voltage at *C* would no longer be $7\frac{1}{2}$ but would drop slightly below this value as measured with respect to *A*. The voltage from *A* to *D* would still be $7\frac{1}{2}$, so a voltage difference would now exist between *C* and *D*. In conventional electronic control circuits, an electronic relay connected between *C* and *D* operates a motor whenever a voltage difference exists between these two points. *R2* is then replaced with a temperature sensitive resistor which varies in resistance approximately 0.24 percent per deg. As long as *R2* is at the same value as *R1*, and *R3* and *R4* are still equal, the bridge is said to be "balanced"—as zero voltage difference exists between *C* and *D*. At the slightest variation in temperature of the sensitive resistor *R2*, the electronic relay detects the voltage appearing between points *C* and *D*, discriminates as to whether the change was due to a rise or fall in temperature, and operates a motor to make a correction.

In the air velocity control circuit, both *R2* and *R4* are temperature sensitive elements. Since the resistors in the lower branch, *R3* and *R4*, have only one-fifth the resistance value of the upper branch, *R1* and *R2*, five times the current flow will exist in the lower leg. Five times as much power will therefore be dissipated in *R3* and *R4* as is dissipated in *R1* and *R2*.

Fig. 5 is a photograph of the sensing element. The small resistance winding at the end of the element is *R4* and the larger winding is *R2*. The windings are identical except for length, *R4* having only one-fifth the area and resistance of *R2*. Since *R4* is handling five times the power of *R2*, its temperature will rise considerably more than that of *R2*. The temperature rise in *R2* is only about a degree, and the rise in *R4* is in the neighborhood of 25 deg.

When the sensing element is exposed to any body of still air, there will be a constant temperature difference between *R2* and *R4* of approximately 24 deg. The system is then calibrated so that it is in balance with this constant temperature difference. (The method of calibration will be shown later). An increase in ambient temperature will now increase the values of both *R2* and *R4*. If the increase is one degree the variation in resistance will be, as mentioned earlier, 0.24 percent of the earlier resistance value. In ohms, the change in *R2* will be five times the change in *R1*. But, since the resistance change is the same percentage of each, the 1 deg change in temperature has the same effect on both legs of the bridge. The bridge will still be in balance. The system might then be considered a differential temperature controller in which the voltage across points *C* and *D* represents the variations in the temperature difference between *R2* and *R4*. As long as this difference remains constant the bridge will be in balance, regardless of absolute temperatures.

Consider now the effect of air movement about the element. The large temperature rise in *R4* will be reduced slightly because of the more rapid heat removal produced by the moving air, while *R2* remains nearly constant. Therefore, the temperature difference between *R2* and *R4* will decrease slightly, creating a voltage between points *C* and *D*. The electronic relay connected between points *C* and *D* will now give a signal indicating that the velocity has risen.

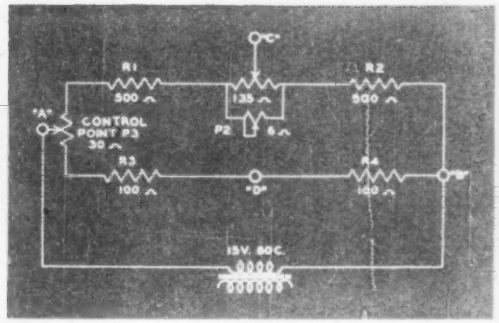
### Calibration Establishes Velocity Control Point

The system can be calibrated for any temperature difference from zero up to about 24 deg. If the system is calibrated for 24 deg it will mean that it is controlling at zero air movement and will create a signal on any disturbance in the air. If the system is then calibrated for a smaller differential temperature, some air movement will be required over the element to keep the bridge at balance, i.e., zero voltage between *C* and *D*. In effect, this calibration establishes a velocity control point. If the system is once set up for a particular velocity, any variation from this velocity will create a variation in the temperature difference which will be picked up by the electronic relay. Variations in ambient temperature, while affecting the resistances of *R2* and *R4*, will not change the ratio of their resistances, and will therefore have no effect on the voltage between points *C* and *D*. (Actual tests have carried the element temperature from 70 F to over 240 F with no noticeable variation in control point).

Because the elements are wound of the same thickness wire throughout, both the small winding and large winding present the same area in proportion to mass; so variations in radiant temperature are also effectively balanced out. However, precautions are taken in the installation of the element so that any radiant effects are uniformly distributed over both element windings.

Fig. 6 illustrates a more complete bridge circuit. There are no changes except that a motor follow-up potentiometer, *P1*, is wired into the bridge circuit, point *C* now being the wiper of the potentiometer. Once the control point of the system has been set up with the motor in its mid-position and with the system in equilibrium, a variation in air velocity will again create a signal from points *C* to *D*. Assume that the velocity has dropped slightly. The temperature of *R4* will now rise, creating a larger differential temperature. The electronic relay across points *C* and *D* will sense an unbalanced condition and will rotate the motor in a direction to provide more air to the system. As the motor rotates, the wiper of the follow-up potentiometer *P1* will move slightly toward the left. It will seek a point which is at the same voltage as point *D*. When it reaches this point, the electronic relay will sense the balanced condition and stop the motor in its new position. In this manner proportioning control is achieved.

Since the standard motor follow-up potentiometers are 135 ohms, some provision must be made for increasing the effect of the thermostat or sensing element on the motor potentiometer. For example, in order to drive the motor all the way through its operating range, the bridge circuit would have to produce a change equivalent to the 135 ohm change produced at the motor. In order to make the throttling range of the system adjustable, the 135 ohm potentiometer is retained and a second variable resistor, *P2*, is added across the motor



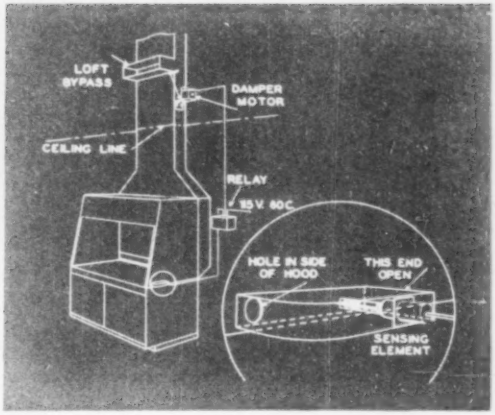




**Fig. 8 *(left)*—Method of calibrating the system, by means of an adjustable potentiometer *P3*. Fig. 9 *(right)*—Details of an installation. The insert shows the sensing element located in a small bypass elbow duct in the side of the hood**

potentiometer as shown in Fig. 7.

This rheostat is variable in resistance from 0 to 6 ohms. If it were set for 0 ohms, the motor potentiometer would be completely shorted out and would have no effect on the circuit. On a drop in velocity, the electronic relay would rotate the motor in a direction to provide more air, continuing until the velocity had picked up to the control point once more. Obviously, this is an unstable condition because the motor will over-control in order to pick up the velocity, resulting in a slightly higher velocity at the sensing element. If the motor action were slow enough, this method of control might be desirable because there is no inherent drifting of control point due to throttling range. However, on velocity control systems, it is desirable to use motors with fast timings. Therefore, a small amount of throttling range is used. If the throttling range potentiometer *P2* were set for 3 ohms, then a 3 ohm change in the bridge circuit would be necessary to drive the motor through its entire operating range. Three ohms of throttling range resistance, which is the mid-position on this adjustment, provides a throttling range of approximately 10 percent. In other words, if the control point is 100 fpm, the motor will be wide open at a velocity of 95 fpm and fully closed at a velocity of 105 fpm.

The method of calibrating the system is shown in Fig. 8. An adjustable 30 ohm potentiometer, *P3*, is wired at *A*. If the system is in balance at any point it can be thrown out of balance slightly by readjusting the wiper of the control point potentiometer. For example, moving the wiper downward would be in effect the same as dropping the value of *R3* slightly. In turn, dropping the value of *R3* is the equivalent of raising the resistance of *R4*. Since the resistance of *R4* increases on a drop in velocity, moving control point potentiometer *P3* wiper downward would affect the circuit exactly the same as a drop in velocity and the system would now control at a slightly higher velocity to keep the bridge in equilibrium.

The control point and throttling range potentiometers are the two principal adjustments in the system. A third setting, sensitivity, affects the electronic relay directly and serves to stabilize the system by reducing the inherent high sensitivity of the electronic system.

## How Equipment Is Installed

Fig. 9 illustrates the details of installation. A panel is provided to contain the electronic relay and adjustments in the circuit. The damper motor is mounted on the duct and in this application controls face and bypass dampers. The sensing element is located in a small bypass elbow duct in the side of the hood. This location is used because of many factors. Attempting to sense the actual entering velocity is difficult because of the chance of interference with the element, either by barriers or by actual physical contact. If the entering air is held constant at any point, however, it should be constant at any other point. Therefore, an out-of-the-way location is possible. A small hole is drilled in the side of the duct immediately off the work surface. The elbow duct is mounted over the hole. If an explosion or other blowback occurs, the fumes will be blown back toward the wall instead of out into the laboratory. The element location is away from the hole so that there is little chance of direct radiant energy striking one winding without striking the other. The hole is low in the side of the hood to eliminate the chance of blowback because of high thermal heads which might build up within the hood. Since this model of the element is nondirectional, a back draft would seriously hamper its operation. However, there is little or no chance of this occurring at the location shown.

In setting up the system, it is necessary only to measure the incoming face velocity with some reasonably accurate method and to set the control point for the desired velocity. The maximum permissible throttling range is used on the system. Then, any tendency to hunt or cycle is eliminated by reducing the sensitivity.

It is a simple matter to mount auxiliary switches on the motor to give an alarm whenever the damper goes wide open, indicating insufficient exhaust, or when the damper goes fully closed, indicating a malfunction of some kind in the system. These same auxiliary switches can perform other functions—such as setting up control points of other regulators in the system to compensate for dirt accumulation in filters, etc.

# Oberlin College Served by *New Central Heating Plant*

*LESTER S. RIES, superintendent of the department of buildings and grounds at Oberlin College, describes the new central heating plant which now carries 75 percent of the campus load. Old age, obsolescence and growing pains resulted in the abandonment of the former plant late last year. The new installation, housed in an attractive structure of modern design, has complete facilities for coal and ash handling and (an important point) is arranged for good operation and maintenance*

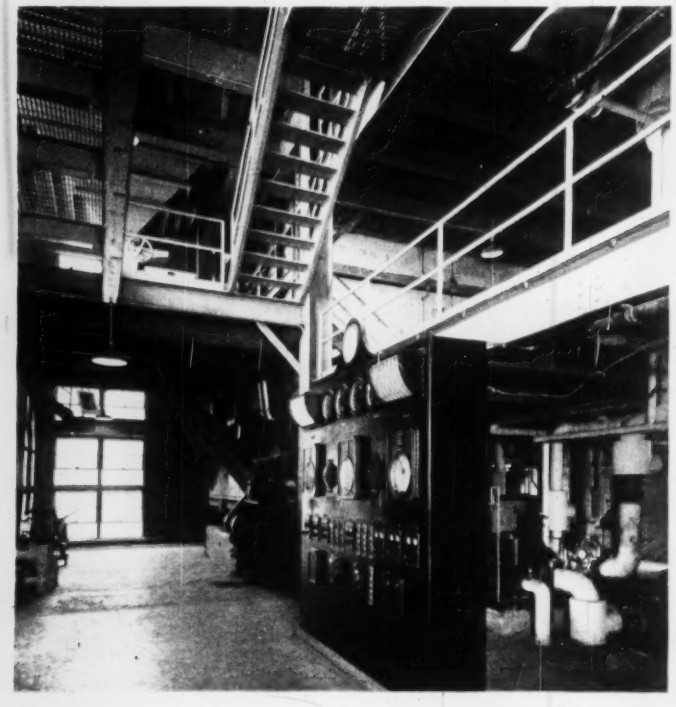
OLD AGE, obsolescence and growing pains are the factors that recently resulted in the replacement of the central heating plant at Oberlin College, Oberlin, Ohio, with a modern installation adequate for the requirements (see front cover).

Original heating installations were housed in separate buildings that dated back to 1883. A letter written that year and still on file in our office indicates that the Barstow Stove Co. offered to sell the College "three furnaces as shewn in the enclosed cut at wholesale price—say $65 each—and I, as an individual, will contribute $100 towards the payment of the bill." The letter was signed by A. C. Barstow.

There is no clear-cut record as to what happened with heating devices in the College buildings. Undoubtedly, it would show a progression of heaters dating from wood-burning stoves, through the soft coal stove stage, with several stoves in each building. In some buildings one can definitely conclude, from the arrangement of basement walls and partitions, that furnaces were installed to serve one or more adjacent buildings. This was the beginning of central heating at the College.

In 1913, two 300 bhp boilers were installed in a central heating plant structure designed for burning natural gas, which was locally available. By the time the boilers were installed, the local gas supply had dwindled and become uncertain and coal was substituted. Steam was generated at 125 lb gage and reduced inside the boiler room walls to 3 or 4 lb pressure. The transmission piping radiated from the boiler room in sizes up to 15 in. and was routed in straight lines from one building to another; thus, the heating of buildings farthest from the boiler house was subject to interruption of service should a catastrophe such as a fire occur in any of the buildings between it and the steam source. In 1916, another boiler was added, making a total installation of 900 bhp.

In the course of time, more buildings were connected to the central heating plant load and the capacity of the plant was reached several



**View of the operating floor, showing the panel board, boiler feed pump at right, coal bunker upper left, coal spreader and stoker mechanism of boiler at left of center. The forced draft fan is at extreme left on the operating floor**

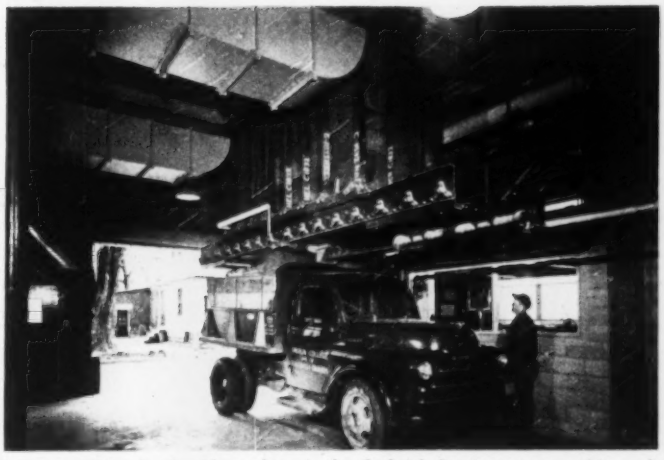
years ago. The plant auxiliaries were obsolete so that it was necessary to fabricate replacement parts for them. In 1946, it was obvious that the old plant could not carry on much longer on an economical basis and, through the good offices of President William Edwards Stevenson, the trustees authorized the replacement of the old plant with modern facilities. The first fires in the plant were kindled late in October 1949. The boiler brickwork was dried out, and on December 2, 1949, the old plant was permanently abandoned and the heating load taken over by the new one.

### Building Is of Modern Design

The two new boilers are housed in a beautifully proportioned building designed in the modern motif, to which is joined the service building of the department of buildings and grounds. The exterior of the heating plant is blond brick laid up in Flemish bond, the bottom 18 ft being faced with buff Indiana limestone. The roof line, including all setbacks, has no parapets, giving the building an air of smartness. The vertical walls of the first setback are sheathed with grey porcelain covered plates. The remaining two have blond brick walls typical of the main surfaces. Each elevation has a single large unit of fenestration, the glass elements of which are separated by grey porcelain coated steel spandrels. The building is 55 ft (north and south) by 80 ft (east and west). The stone course is 18 ft high on three sides (the service building being joined on the south) and the first setback 55 ft above ground.

The top of the "stack" is 90 ft above the ground, as compared with a 176 ft steel stack on the old plant. The "stack" on the new plant constitutes the final setback and is 18 ft x 20 ft and emerges 20 ft higher than the level of the setback from which it rises.

In the middle of the east and west elevations are large electrically operated doors for ash truck and other related services. These doors are painted a cerulean blue, a touch that enhances the beauty of the entire design. Situated on one of the main thoroughfares of the village and on a state highway, and located in the immediate vicinity of Oberlin College hospital, Hales gymnasium for women and Crane swimming pool, there is nothing about the heating plant structure to detract in any way from the surroundings.



**Ash removal is simple. Shown here is the firebrick lined water quenching ash hopper with its horizontal hydraulically operated gates**

### Boilers Operated at 125 Lb

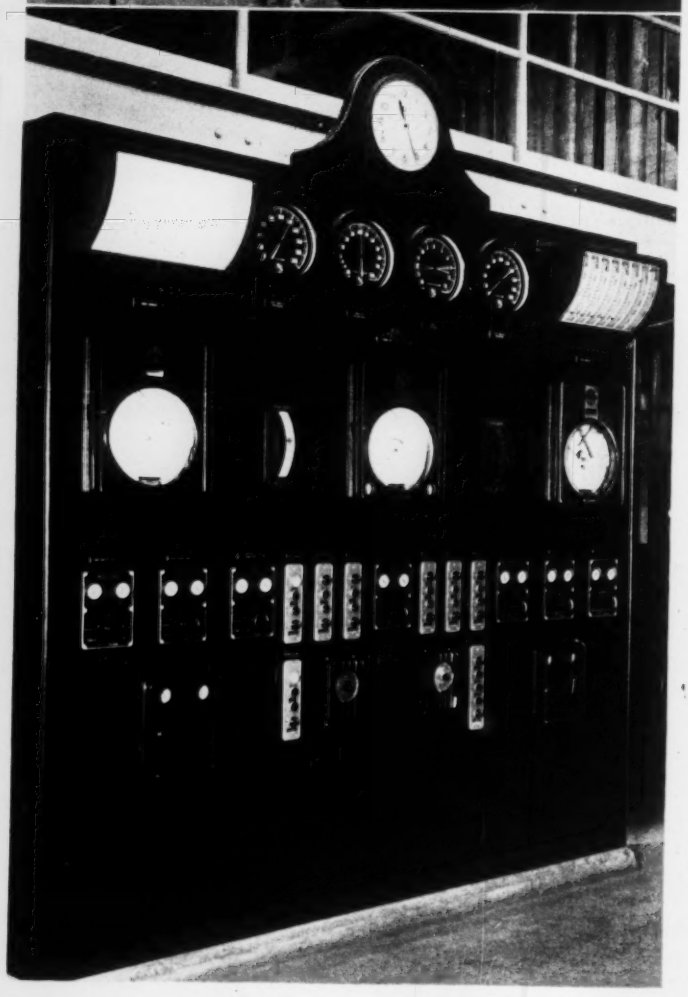
There are two identical boilers of 618 bhp rating each located 18 ft above the ground floor. The boilers have three steam drums, two of which are 42 in. in diameter and one 36 in. and a mud drum of 42 in. diameter, a total heating surface in each boiler of 6185 sq ft. The boilers are designed for 200 lb generating pressure and are operated at 125 lb gage. The furnace is 11 ft wide, 13 ft long and 37 ft high. There are 506 $3\frac{1}{4}$ in. generating tubes, 10 $3\frac{1}{4}$ in. circulation tubes and 42 water wall tubes $3\frac{1}{4}$ in. and $4\frac{1}{4}$ in. in diameter, so arranged that a maximum of heat absorption takes place. The brick walls are 18 in. thick with high temperature Missouri firebrick on the inside and less resistant firebrick on the exterior. The baffles are so arranged that the hot gases make four passes through the tubes before entering the breeching. Each boiler is equipped with feedwater regulators, a water test coil for taking off boiler water samples, and remote water level indicators.

The fuel is burned on a chain grate stoker 10 ft wide and 13 ft. 9 in. long, with a total grate area of 135 sq ft. The driving units are equipped with a $1\frac{1}{2}$ hp motor and a 2 hp steam turbine. The travel of the chain grates is up to 30 fpm.

Coal is delivered up a slight ramp to a hopper 12 ft by 12 ft equipped with a grille with openings 3 in. x 6 in. The coal is then fed by means of a rubberized endless belt 24 in. wide into a motor operated bucket elevator, with a 10 hp motor. The elevator is equipped with 110 buckets, 12 in x 7 in. x $7\frac{1}{4}$ in., and has a speed of 300 fpm, and a capacity of 35 tons per hr. The elevator is 85 ft, 6 in. high.

The contents of the buckets are discharged into a small hopper and fed by an 8 in. diameter screw conveyor with a speed of 86 rpm to each bunker. The coal is dropped into a $\frac{5}{16}$ in. thick steel plate bunker with a capacity of 150 tons. The coal is then dropped through a scale, 200 lb at a time, which is equipped with a cyclometer which totalizes the 200 lb slugs of coal. From the scale the coal enters a conical spreader and is distributed onto the chain grates. At the tail end of the stoker the ash is dropped into a brick-lined quenching hopper 4 ft wide, 14 ft long and 6 ft deep, the bottom of which consists of horizontal hydraulically operated gates. These gates, when opened, drop the ash directly into trucks and from there it is carted away.

The forced draft fan is located on the operating floor. The underfire air is supplied through five adjustable windboxes and the air is admitted to the under side of the stoker. The supply for the forced draft fan is a vertical duct, the inlet



of which is level with the top of the boiler, thus supplying warmed air. The fans are dual connected and have a capacity of 15,100 cfm each, 6 in. static pressure at 105 F, and operated at 1765 rpm. The motor drive is 20 hp. At the opposite end of the fan shaft is a non-condensing steam turbine operated at 125 lb gage pressure and up to 10 lb gage back pressure.

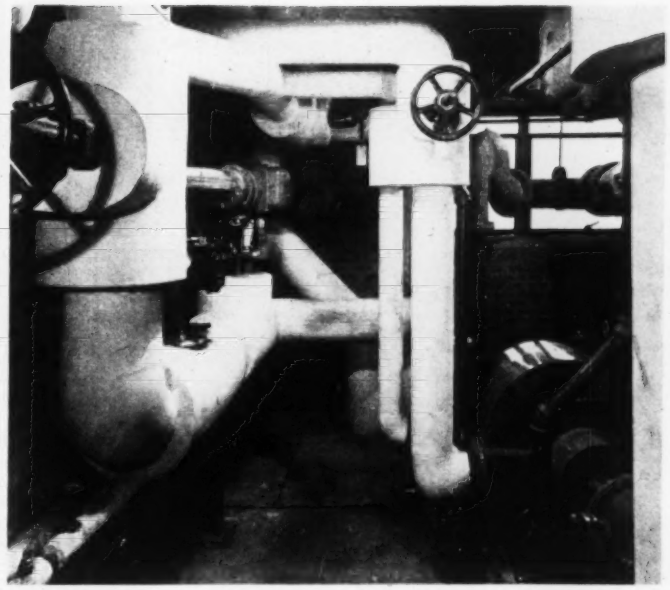
The induced draft fan is at the top of the boilers and set in the boiler breeching. The fan is 51 in. in diameter, operates at 880 rpm and has a capacity of 70,000 cfm at 2.75 in. static pressure at 625 F. It is connected with couplings to a 60 hp electric motor at one end of the shaft and a steam driven non-condensing turbine operating at 125 lb gage steam pressure and up to 10 lb gage back pressure.

The deaerator is a vertical cylinder 4 ft in diameter and approximately 7½ ft high directly connected integral with a horizontal storage cylinder 5 ft in diameter and 12 ft, 2 in. long. The deaerator operates up to 10 lb gage pressure and has a capacity of 60,000 lb per hr. After passing through the heater, the oxygen content of the effluent is guaranteed not to be in excess of 3 100 cubic centimeters per liter. The storage tank holds 220 cu ft of condensate and the overflow is connected to the sewer through a 23 ft high loop seal of 6 in. diameter pipe.

The condensate from the campus lines is handled through a vacuum pump operated at 19 to 22 in. of vacuum and pumping up to the deaerator. The pump has a capacity of 220 cfm of air at 12 in. of vacuum. The vacuum condensate return pumps are dual centrifugal pumps; one driven by a 10 hp electric motor and the other by a steam turbine.

The boiler feed pumps are dual

***Top*—A water testing laboratory is installed on the operating floor for daily analyses of oxygen, chlorides, phosphates and alkalinity of boiler water samples. *Bottom*—Close-up of the panel board, showing draft gages; steam pressure indicators; recording meters; master recorder for steam pressure in boiler, campus line steam pressure and vacuum on campus return line; steam flow-air flow meters; boiler water level indicators; manual and automatic control panels; timers; and pushbutton controls for starting and stopping electrical equipment**



**Lift fitting shown at right of center of this view is used to lift water from the condensate return line from the campus. Machine in right foreground is the turbine driven vacuum return pump. Motor operated steam valve at left controls steam to campus. Exhaust steam line to campus is at left of center**

installed. The pumps are centrifugal, two-stage, single suction, to deliver 200 gpm when handling boiler feedwater at 212 F. One pump is driven by a 60 hp motor and the other by a 54 hp steam turbine operating at 125 lb gage and up to 10 lb gage back pressure. Boiler water samples are analyzed daily and dosing in the boiler feed line is accomplished by means of two motor operated chemical injectors.

### Panel Board for the Plant

The operation of the heating plant is controlled by means of a panel board on which the following equipment is installed:

Recording meter for steam flow-air flow and flue gas temperature for each boiler.

Recording meter for steam header pressure, temperature of condensate return, pressure of steam in Lorain St. main.

Clock.

Boiler pressure gage for each boiler.

Steam main pressure gage, Lorain St.

Vacuum return gage.

Boiler water level indicator for each boiler.

Draft indicator for each boiler, showing windbox pressure, compartments Nos. 1-5 inclusive, furnace draft, uptake draft.

Control panels for induced draft, forced draft, stoker, master control.

Elsewhere in the plant are a recording low pressure steam main gage, a barometer, a recording outdoor thermometer, a condensate return recording meter, and a recording gage for boiler feed pump discharge pressure.

A completely equipped water testing laboratory is installed on the operating floor. Daily boiler water samples are taken and analyses run for oxygen, chlorides, phosphates and alkalinity.

The steamfitting shop on the ground floor houses most of the larger tools, including a pipe cutter and welding outfit. Facilities for testing traps, thermostats and other special devices are available.

Steam is taken out of the steam drums at the top of the boilers through a 6 in. line down to a 10 in. header on the mezzanine floor 10 ft above the ground floor. From the header the steam passes downward through a motor-operated valve into the underground distribution system.

The steam turbine exhaust from the several turbine-driven units is routed through a header to the 10 in. underground distribution line serving the hospital, gymnasium and swimming pool. The service building and later the new College market will be heated with turbine exhaust.

Daily records are maintained showing outside temperature, degree days, coal consumption, pounds of steam delivered to the campus lines, evaporation per pound of coal and the pounds of condensate return and raw water make-up.

The heating plant has a suitable office for the operating engineer and a locker room equipped with toilet facilities and shower for the operating crew.

Chris Oliver is the operating engineer, William C. Kammerer and Associates, Cleveland, the plant designing engineers, and Eldredge Snyder, New York, the associate architect.

## DEW POINT RECORDER AIDS WATER PURIFICATION

A DEW POINT recorder and a new water purification process are giving a springwater taste to water from the Schuylkill river, according to engineers of the General Electric Co. The new Welsbach Corp. plant, Philadelphia, is said to have the largest water purification installation in the United States using ozone to kill river water bacteria. It is one of several water purification plants in Philadelphia using the method.

In the ozone process, outside air is compressed, cooled and dried. Then the air is blown past banks of metal plates charged with high voltage. The electricity from the plates causes an electrostatic discharge to take place within the passing air, producing ozone, an unstable form of oxygen.

As the air passes over the metal plates which cause the electrical discharge, it must have a very low moisture content. To assure that moisture in the air remains constant during the process, the dew point recorder is used. The instrument gives a continuous record of air dryness, accomplishing this by measuring and recording the temperature at which moisture in the air condenses on a mirror's surface.

# Water Conservation Highlight of Refrigerating Engineers Meeting

*HIGHLIGHT of last month's spring meeting of the American Society of Refrigerating Engineers was a water conservation conference. An attentive group heard many of the complex problems discussed, and topics ranged from fundamental considerations of utility rate structures to cooling tower maintenance procedures. HPAC's report on other sessions at this meeting will be concluded in a subsequent issue*

ONE OF the highlights of the 37th spring meeting of the American Society of Refrigerating Engineers, held last month in Kansas City, Mo., was a water conservation conference which was not only well attended but at which members displayed keen interest in the many problems of water re-use.

R. M. Westcott, of Pomeroy and Westcott, presided at the session and opened the conference by stating that water re-use is gaining more and more public attention so that it behooves the air conditioning and refrigeration industry to practice conservation.

D. D. Wile, chief engineer, Refrigeration Engineering, Inc., briefly reviewed the papers on water conservation which were presented at the society's annual meeting last December. In covering the paper Refrigeration and Problems of the Water Supply Industry, by E. L. Bean, principal assistant engineer, Philadelphia Bureau of Water, he pointed out that it is the life work of 80,000 people to secure the supply, pump, purify, chemically treat, transport, distribute and deliver the 8.5 billion gallons required in the country each day. It is likewise the work of probably 50,000 people to supply the second half of the water supply service required; that of collecting, transporting, treating and disposing of the used waters or wastes. It was also pointed out that water supply and waste disposal facilities are needed to the extent of about a $7.8 billion investment. Later, in the discussion period, Mr. Wile stressed the fact that the investment required to furnish additional water to meet the needs of the air conditioning and refrigeration industry alone is a staggering sum which must be paid by someone.

Quoting Mr. Bean's paper further, he asked, "In view of the high demands of other industries, why should air conditioning be selected for special control? Is it just a spectacular item? Why pick on air conditioning?" Reasons given included the fact that air conditioning installations are largely located in downtown areas where water main and sewer problems exist and the fact that installations generally represent a high peak demand and a low load factor. In discussing the economics of water supply, Mr. Bean indicated that the economy of the individual water system must be ignored in favor of average conditions and costs. Recognizing that accounting practices of water utilities vary a good deal, it was stated that where water is scarce, $1400 per ton of refrigeration might be considered as the investment required for supplying additional water for air conditioning. A figure of $4 to $119 per installed ton might be considered as the annual water cost for air conditioning where conservation equipment is not used. The great difference in the figures reflects different localities and different accounting practices used. The $4 figure represents a rate structure designed to encourage use and the $119 figure was said to represent conservative business practice. Mr. Wile continued by saying that these figures can be virtually doubled to include water disposal.

Speaking of the limit of conservation, Mr. Bean's paper pointed out that the amount of water per ton which should be allowed for conserved units appears to be controversial. In his opinion, it seems reasonable to set a limit of 0.1 gpm per ton, wherever water hardness is less than 170 ppm, but to increase this where water has greater hardness to 0.1 gpm per ton for each 85 ppm of total hardness.

The next paper briefly reviewed by Mr. Wile was one on cooling tower selection for refrigeration and air conditioning, covering the economics of water re-use, by H. E. Degler, technical director of the Marley Co., Inc. In this paper it was pointed out that when water is used as a coolant on a once-through basis and then thrown to waste, each pound will remove only 20 to 30 Btu from the system. If the water is recirculated and recooled (with atmospheric air) by evaporation and convection, each pound evaporated will remove 1000 Btu or more from the process. It was also stressed that the lowest temperature to which water may be cooled in the contact type of cooling equipment is the temperature of adiabatic saturation, i.e., the wet bulb temperature of ambient air. Dr. Degler indicated that performance is measured in terms of approach (cool water temperature minus the wet bulb temperature) when cooling the water through some desired temperature range. In his opinion, the optimum approach for a cooling tower is 7 deg when used with air conditioning equipment and when the wet bulb temperature is 78 deg. He believes a 10 deg approach sufficient for some commercial refrigeration jobs. It was

pointed out that a close approach requires a larger and more expensive tower than a long approach. The paper also mentioned that the amortization of cooling tower costs can be accomplished in three years or less with 50 ton and larger jobs.

Mr. Westcott's paper next came up for review at this session. He said the design of the equipment means nothing if water is allowed to interfere with good performance. Stating that water quality varies from place to place and from time to time (variations of from 5 to 600 ppm have been found in the same city) Mr. Westcott's paper indicated that liberal design in old equipment often permitted the plant operator "to get by" but today this is not the case, particularly with the newer high capacity equipment. Some "rackets" in the water treating field were cited and it was recommended that the services of a water consultant be purchased from one source and the chemicals used in treatment be purchased from another.

Mr. Westcott's paper also outlined various procedures and treatment for the control of scale, corrosion, algae, and slime.

### Sample Water Conservation Ordinance

A committee of the American Water Works Association has recently formulated a sample ordinance for restricting the use of water for air conditioning. L. L. Lewis, Carrier Corp., has been a member of this committee as an "unofficial representative" of the ASRE. He stated that after two years of work, a model ordinance had been drawn up by the committee and hastened to add that this ordinance can only be used as a basis for working out local problems.

He emphasized the fact that the committee recognized two general types of problems; first, where there is a problem of the community in regard to pumping water from a water table which is becoming lower and lower, and secondly, the problem of economics; that is, the capacities of mains, filter plants, etc. "It is obvious," he said, "that such questions as to whether it is wiser to enlarge mains, sewers, and pumping facilities (where the basic water supply is adequate) or whether it is wiser to conserve water use is a local problem." Mr. Lewis stated that in his opinion the general features of the ordinance are good, and he stressed the fact that in terms of future water requirements for air conditioning, the 5 and $7\frac{1}{2}$ ton units would represent the largest consumption. The ordinance does not suggest any restrictions for air conditioning units of 5 tons or under. It is suggested that 3 gpm per ton be allowed for the larger jobs where it is impractical to install conservation equipment. This would be dictated by piping problems, location of equipment, etc. The ordinance suggests a sliding scale of gallons per minute per ton for various amounts of hardness encountered so as to reflect the need for blowdown.

After mentioning the possibilities of using demand meters, Mr. Lewis outlined the problems of relating horsepower to tons and of defining a customer, particularly in the case of large buildings. In concluding, Mr. Lewis recommended that ASRE members recognize that cooling towers will add to the cost of the job. However, in his opinion, there seems to be no alternative in certain communities and he suggested that members recognize conflicting interests and the importance of wise action in regard to regulatory measures. He emphasized the fact that the air conditioning industry must help and guide the code makers in order to protect its own business but he said the industry should not be the "whipping boy". "It would be in order," he said, "to bring other large water user groups to the attention of the public regulatory bodies".

### Cooling Tower Maintenance

Next on the program was a paper dealing with the maintenance of water conservation equipment, by Mr. Westcott, who started off by saying that initial efficiencies of water conservation equipment are supplied by manufacturers and are based on short term tests. Continued high efficiency is dependent upon adequate records of performance in order that a falling off of efficiency may be detected quickly.

In Mr. Westcott's opinion, manufacturers can assist by recognizing the maintenance problems likely to be encountered on their equipment. For example, a package air conditioning unit originally designed for straight water cooling, when used with conservation equipment will be subjected to severe concentrations and the manufacturer, therefore, has a serious responsibility. After citing a number of instances where adequate cleanouts were not provided, he stated that maintenance cannot be performed unless the equipment is designed for it and unless careful records of operation are kept to indicate the necessity for such maintenance. He also pointed out that the contractor has a number of definite responsibilities for insuring continued and adequate maintenance and that likewise the owner is responsible for providing the necessary funds for adequate maintenance.

In discussing remedies for water problems, he emphasized that there is enough known about water chemistry so that a good job can be done. Moreover, he continued, basic materials are relatively cheap, but all treatment and maintenance requires the cooperation of the operating man.

At this point in the conference, two operating men were asked to

## REFRIGERATION SAFETY CODE APPROVED

**The proposed American Standard Safety Code for Mechanical Refrigeration, which was sponsored by the American Society of Refrigerating Engineers under the rules and regulations of the American Standards Association as project B9, was approved by the ASRE at its recent 37th spring meeting. It has also been approved by the ASA and is expected to be widely used throughout the industry. Copies of the code (ASA B9; ASRE Standard 15) may be obtained from ASRE headquarters, 40 W. 40th St., New York 18.**

tell members some of their experiences with cooling towers. Joseph Leto, Jr., Merchants Refrigerating Co., has four cooling towers in use five to six months of the year. He said that one tower, not painted regularly, has given a good deal of trouble and that as a result the casing had been replaced with $^3/_8$ in. thick material composed of portland cement and asbestos fibers. He expects this change to eliminate the corrosion problems.

In his opinion, atmospheric towers are not suitable for use in the St. Louis area because efficiencies are lower when the load is the highest. He urged that valve operations be checked periodically and stated that his experience with roof coatings, when the roof surface is used as the pan under the tower, has not been satisfactory.

J. H. Schmall, of the Muehlebach hotel, reported that there are 500 tons of air conditioning in the building and that a forced draft cooling tower was installed in 1932. At the present time, 1400 gpm are circulated through the tower and he has not cleaned condenser tubes in four years. However, under maximum load conditions the tower is treated with chemicals three times a day. In addition, it is bled constantly, sometimes as much as 10,000 gal per day. Mr. Schmall knows of several jobs of a similar nature in Kansas City where condenser tubes have been replaced every 2 to 6 yr. He has checked his own ferrous tubes frequently but has not replaced any in 16 yr. According to Mr. Schmall, the maintenance cost for this tower, which is used about 5 mo each year, is about $50 per yr. The tower is of California redwood which has not been painted. The fan housing inside the tower is painted every year, however, and about 6 a.m. every Sunday the tower is drained and the basin and nozzles are cleaned. Then it is turned on and immediately given a heavy water treatment dosage.

M. P. Hatcher, Kansas City water commissioner, who was asked to make a few remarks, stated that he was most interested in this conference and that as a member of the American Water Works Association he was keenly interested in the problem, particularly because of the water situation in his city. He stated that a charge of 10 to 12 cents per 100 cu ft is, in general, the present cost for air conditioning water. There is no doubt in his mind that this will be increased. He believes that a good deal of the answer to the water shortage problem lies in the price of water.

### Use of Conservation Equipment Increases

The session was then opened to questions from the floor and Tom Carroway, Dallas, rose to ask if there were any 10 yr statistics on the increase in use of conservation equipment. Dr. Degler answered by saying that in 1930 the annual volume of business of his company amounted to approximately $\$^1/_2$ million. This year it will probably be about $8 million. He also pointed out that his company is doing a large business in small and large towers but that the increase in business is not nearly as pronounced in the medium sized towers.

A number of questions were next asked regarding the probable effect of increased water rates on the design and installation of air conditioning jobs. Leon Buehler, Jr., chief refrigeration engineer, Creamery Package Mfg. Co., cited the possibilities of using higher head pressures and air cooled compressors. Mr. Wile pointed out that the necessity of using conservation equipment may, in some cases, rule out the use of individual small units in favor of the central chilled water system.

H. J. Prebensen, vice president, Air Comfort Corp., said that while Chicago now has cheap water and an abundance of it, the handwriting on the wall can be seen, particularly as a water disposal problem is virtually at hand in the loop area. He reported that in some buildings single towers of over 100 tons capacity are being considered to serve a large number of small conditioning units. To date, however, the selection of conservation equipment has mainly been based on economic considerations. He said that often the cost of a new water service to the street for air conditioning water is more expensive than the conservation device required. Previous to the war, he reported, less than 5 percent of the jobs installed by his company included water conservation equipment. Last year, a considerable portion of the total installations included such equipment.

Clarifying a previous discussion, Dr. Degler stated that the amount of water used for cooling tower blowdown generally ranges from 0.10 to 0.20 percent of the circulation, if the blowdown is used for reducing concentration. Getting back to the question as to why the industry shouldn't be whipping boy, he cited increased population and commercial and industrial expansion as having overburdened water supply and distribution systems. Then too, he said there is the matter of stream pollution and the tremendous increase in ground runoff water. All of this means high peak demands, particularly when related to existing capacities, and air conditioning water requirements are adding to a bad situation.

E. T. Benson, of Dayton, recommended that all types of water users be included in regulatory discussions.

L. V. Cressy, of James M. Todd and Associates, New Orleans, reported that his city does not permit installations of over 3 tons without conservation equipment. He said that he has used a number of water wells but three years ago he ran into sewage problems and at the present time restrictive measures are enforced largely because of disposal problems. He pointed out that the price of water was raised from 10 to 13 cents per 100 cu ft to discourage air conditioning use. To date, the increase has had no appreciable effect, he said.

E. T. Nichols, of Carneal & Johnston, architects and engineers, Richmond, asked Dr. Degler if better control of towers should not be provided—particularly for reduced load conditions when wasted drift occurs (as when the full water rate and full air rate are used). Dr. Degler answered by stating that price is probably the most important factor. He said that there are automatic on-off controls which are related to cold water temperature and which are available. He also suggested the use of two speed motors and recommended that control be done on the air side rather than on the water side of the tower.

In bringing to a conclusion this animated discussion, members in attendance recommended that the model ordinance of the American Water Works Association be brought to the attention of all ASRE members.

# Bright Future for Air Conditioning, Refrigeration, Says New ACRMA Head

## *Products Are Basic Essentials, Says Shanklin*

WITH AN ATTENDANCE "larger than any in its long history," the Air Conditioning and Refrigerating Machinery Association, in its annual meeting at Hot Springs, Va., climaxed a year's successful operations, which included activities in the fields of codes and standards formulation, statistics and marketing; foreign sales promotion and inter-industry relations. A number of ACRMA's product sections also met during the three days.

Arthur P. Shanklin, vice president of Carrier Corp., was elected ACRMA president, succeeding W. H. Aubrey, of Frick Co. G. E. Wallis, of the Creamery Package Mfg. Co., was named first vice president; F. H. Faust, General Electric Co., second vice president; and G. A. Heuser, Henry Vogt Machine Co., treasurer.

In accepting the association's leadership, Mr. Shanklin said,

"In my opinion, to do an effective job we need to do two things within ACRMA. We need to broaden the scope of our activities and we need to attract to us all of the representative manufacturers in our industry.

"There is no industry in the United States with a brighter potential future than the air conditioning and refrigeration industry. Its products are basic essentials. It has seen tremendous advances in product development and application in the past 20 years. It is our responsibility in ACRMA to do all we can to see that the industry continues to grow strongly and soundly for the benefit of the users of the product, which is to our benefit as manufacturers. We must continue to practice that enlightened selfishness by continuing to formulate equipment and application standards to serve as guideposts for our customers and the sound growth of the industry; we must continue to provide statistical data so that we may intelligently plan our production and sales; we must continue to tell, on every possible occasion, of the essentiality of air conditioning and refrigerating equipment for its multitude of commercial and industrial uses. If we do these things, we will continue to be able to meet, with confidence, strength, and effectiveness, many of the problems which are a daily challenge to the industry's progress and development."

### Safety Code "Architects" Are Honored

Singled out for special honor were six men from ACRMA member-companies who were felt to be "the principal architects" in the formulation of the American Standard Safety Code for Mechanical Refrigeration (ASA B9, sponsored by the American Society of Refrigerating Engineers) and whose five years of work on this fundamentally important industry document had been successfully concluded during the year. The men honored by formal resolution at the meeting are: E. T. Benson (Frigidaire), J. R. Chamberlain (York), W. A. Grant and D. M. Abel (Carrier), W. R. Hainsworth, (Servel), and Mr. Faust.

Guest speakers at the meeting were Joseph E. Moody, president of the Southern Coal Producers' Association, and H. B. McCoy, director of the bureau of domestic commerce of the U. S. Department of Commerce. Mr. Moody, for a number of years, was prominently identified with the refrigeration industry.

**Arthur P. Shanklin, new president of the ACRMA, at the speaker's table at the annual luncheon**

In speaking on the subject Washington — Crossroads of Industrial Might, Mr. Moody emphasized particularly the need for those interested in the welfare of business and the maintenance of American free enterprise to take a personal and active part in politics.

"Too many of those engaged in business and industry feel that their personal political responsibility ends with the making of a cash contribution to a political campaign fund. They apparently do not realize that of equal or greater importance is making known to their legislative representatives in Washington their views on the important issues which affect the welfare of industry as a whole," he said.

Mr. McCoy outlined the activities in which the Department of Commerce is engaged on behalf of American business. He particularly stressed the marketing aids available to industry and the efforts of the Secretary of Commerce to clarify the anti-trust situation. Mr. McCoy emphasized the need for and the possible effects of closing the dollar-gap in the foreign trade situation and its essentiality to the future peace and well-being of the whole world.

Elected to ACRMA's board of directors, in addition to the association's officers, were Mr. Aubrey; A. J. DeFino, of Fedders-Quigan; Maynard Ford, Parks-Cramer; T. E. Hoye, Savage Arms; George S. Jones, Jr., Servel; S. E. Lauer, York; H. F. Lehman, Frigidaire; W. C. Newberg, Airtemp; A. B. Newton, Acme Industries; D. Robertson, Universal Cooler; F. W. Smith, Baker Refrigeration; T. E. Smith, Westinghouse; A. O. Vogel, Vilter; and C. E. Wilson, Worthington.

*Methods of Making*

# PIPING FLEXIBILITY

*Analyses*

## A Straight Line Method

*L. E. PARTCH* contributes this month to the group of articles published in HPAC during the last few years on the various methods of making piping flexibility analyses. An article by Sabin Crocker and Arthur McCutchan in June 1946 reviewed these different methods, and suggested that the advocate of each scheme briefly outline its merits and show the solution of two sample problems so that readers could judge the suitability of the different calculation procedures in their own piping work. In commenting on this month's article, Mr. McCutchan points out that the overall results for the two sample problems show that the method has good utility in determining approximately when a line is sufficiently flexible. Where the structure departs greatly from symmetry, the assumption that the central force acts along a line parallel to a line joining the ends of the structure would seem to lead to errors in determining reacting forces and moments. But, he says, for the Hovgaard problem in particular, the results compare favorably with those obtained by other methods. The designer can obtain an idea of the adequacy of a three-dimensional line with extreme ease by this method, he points out*

SOME TIME AGO an invitation was presented in Heating, Piping & Air Conditioning to the various writers on piping flexibility to solve two problems and in response to it, a number of articles have been published on various methods of making piping flexibility analyses. The purpose of this article is to present a calculation procedure so that the reader may make use of it in the solution of his own problems.

Pipe lines arranged in the three dimensions of space present the most difficult problem of a single pipe line designed for flexibility. Any pipe line having bends may be considered as a series of straight sections. The curves are to be divided into a convenient number of straight sections so that the total length of the straight sections is approximately equal to the length of the pipe line with curves. The straight sections will lie at various angles in space.

In this procedure the third dimension problem is given, for the reason that the subject is more completely covered. Single plane problems are simple by comparison, in that a torsional action and a secondary bending action do not exist.

### Assumptions and the Procedure

The assumptions are that:

1. The pipe line is made up of but one size and schedule from end to end, and that the pipe material is homogeneous.

2. The ends of the pipe line are rigidly fixed.

3. Hangers are provided which adequately support the weight and at the same time allow a freedom

*After graduation from the University of Michigan in 1917, the author had five years of mechanical design experience at the Ford Motor Co. (special machines and furnaces). He was then engaged in power plant and process design at Wyandotte Chemicals Corp. up to 1926, after which he spent a year at The Detroit Edison Co. on piping design. He then returned to Wyandotte in charge of steam production (where the "practical" side of piping was observed). He is presently with Giffels and Vallet, consulting engineers, on power plant design.

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of expansion, so that the pipe line may be considered as a free floating system.

4) A single line of action of force is set up by the thermal expansion or contraction and passes through the centroid of the center line of the pipe sections and is parallel to the straight line between the fixed ends.

Referring to Figs. 2 and 3:

1) A plan view of the pipe line is arranged on a drawing so that the fixed ends lie on a horizontal line of the drawing.

2) An elevation is then drawn below the plan. In this elevation, a line is drawn between the fixed ends.

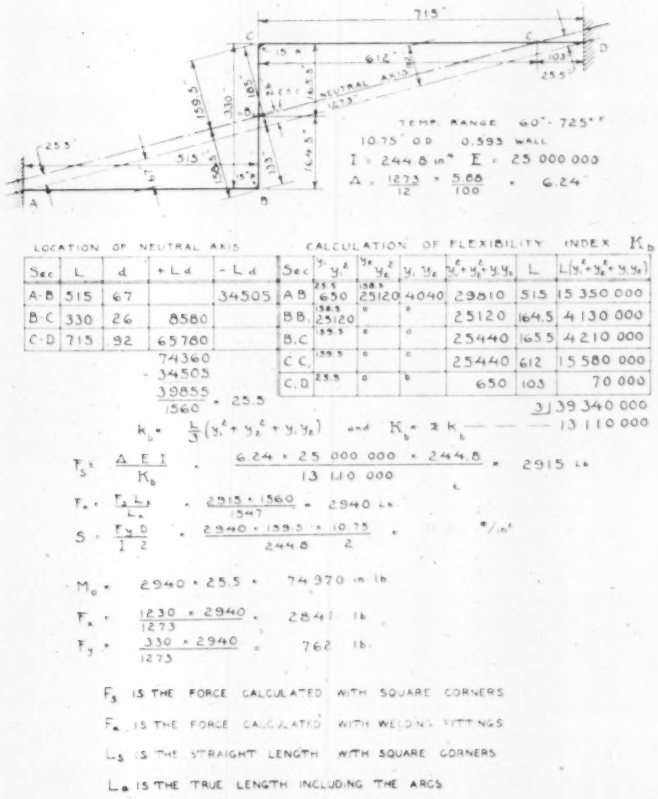
3) A tabulation of the positive and negative moments of the various straight sections is then prepared for both the plan and elevation with respect to the straight lines joining the ends. From this tabulation, the distances from the centroid to the line joining the ends may be calculated in both views.

4) With these distances established, the line of action may be drawn in both the plan and elevation, parallel to the lines joining the ends (see Fig. 2).

5) An end view of the line of action is then drawn, in which the line appears as a point. The fixed ends of the pipe line will appear to coincide (see Fig. 3).

## Computation of Force

Each straight section of a pipe line in space is subject to a primary bending action, a twisting action and a secondary bending action. The resulting movement of these three actions, in the direction of the line of action is the total deflection.




LOCATION OF NEUTRAL AXIS

| Sec | L | d | + L d | - L d |
|---|---|---|---|---|
| A-B | 515 | 67 | | 34505 |
| B-C | 330 | 26 | 8580 | |
| C-D | 715 | 92 | 65760 | |
| | | | 74360 | |
| | | | - 34505 | |
| | | | 39855 | |
| | | | 1560 = 25.5 | |

CALCULATION OF FLEXIBILITY INDEX $K_b$

| Sec | $y_1 y_2$ | $y_2^2$ | $y_1 y_3$ | $y_2^2 + y_3^2 + y_2 y_3$ | L | $L(y_2^2 + y_3^2 + y_2 y_3)$ |
|---|---|---|---|---|---|---|
| A B | 650 | 25120 | 4040 | 29810 | 515 | 15 350 000 |
| B B | 25120 | 0 | 0 | 25120 | 164.5 | 4 130 000 |
| B C | 0 | 0 | 0 | 25440 | 165.5 | 4 210 000 |
| C C | 0 | 0 | 0 | 25440 | 612 | 15 580 000 |
| C D | 0 | 0 | 650 | 650 | 103 | 70 000 |
| | | | | | 3) | 39 340 000 |
| | | | | | | 13 110 000 |

$K_b = \frac{L}{3}(y_1^2 + y_2^2 + y_1 y_2)$ and $K_b = \Sigma k_b$

$F_b = \frac{\Delta E I}{K_b} = \frac{6.24 \times 25\,000\,000 \times 244.8}{13\,110\,000} = 2915$ lb

$F_a = \frac{F_b L_s}{L_a} = \frac{2915 \times 1560}{1547} = 2940$ lb

$S = \frac{F_a D}{I} \frac{2}{2} = \frac{2940 \times 139.5 \times 10.75}{244.8} \frac{2}{2} =$ lb/in²

$M_o = 2940 \times 25.5 = 74\,970$ in lb

$F_x = \frac{1230 \times 2940}{1273} = 2841$ lb

$F_y = \frac{330 \times 2940}{1273} = 762$ lb

$F_s$ IS THE FORCE CALCULATED WITH SQUARE CORNERS

$F_a$ IS THE FORCE CALCULATED WITH WELDING FITTINGS

$L_s$ IS THE STRAIGHT LENGTH WITH SQUARE CORNERS

$L_a$ IS THE TRUE LENGTH INCLUDING THE ARCS

**Fig. 1—For pipe lines in one plane, a drawing is made showing the line of action passing through the center of gravity**

$$\Delta = \Delta_{b1} + \Delta_t + \Delta_{b2}$$

The primary bending deflection is

$$\Delta_{b1} = \frac{F}{E I} k_b$$

The torsional deflection is

$$\Delta_t = \frac{F}{G J} \sin^2 \alpha \, k_t$$

The secondary bending deflection is

$$\Delta_{b2} = \frac{F}{E I} \cos^2 \alpha \, k_t$$

In the above formulas, $F$ is the force resulting from thermal expansion $\Delta$.

In these computations, the deflections may be calculated for a convenient unit of force of, say, 1000 lb. The actual force produced is proportional to the actual deflection.

$$F = \frac{1000 \, \Delta_{actual}}{\Delta_{1000}}$$

The actual total deflection is calculated directly, as the product of the coefficient of expansion, temperature range and the distance between the fixed ends.

$E$ is the modulus of elasticity.

$G$ is the modulus of shearing elasticity.

$$G = \frac{E}{2(1 + i)}$$

$i$ is Poisson's Ratio.

$I$ is the moment of inertia.

$J$ is the polar moment of inertia $= 2I$.

$C$ is the section modulus $= 2I/D$.

$k_t$ is the torsional flexibility index.

In the end view of Fig. 3, normals are drawn from the point representing the line of action to each of the straight sections comprising the pipe line. These normal distances $x$ and the lengths $L$ of the sections, expressed in inches, are tabulated. Values of $x^2$ are also tabulated. Then $Lx^2$ is calculated. This is the torsional flexibility index $k_t$. This same $k_t$ also serves as the index of secondary bending, $k_{b2} = Lx^2$.

$k_b$ is the flexibility index of primary bending.

Again in Fig. 3, where the normals intersect the lengths $L$, are the points of zero primary bending moment. In most of the sections, this intersection divides the length $L$ into two sections. The part on each side of the intersection is treated separately. The projected distance

shown in Fig. 3 from the end of a length $L$ to the point of its intersection with the normal from the line of action, is entered in the table as $y$, expressed in inches.

In case the line of the section has to be extended to meet the normal, then the distance of the near end of the section from the intersection is tabulated as $y_2$. Then the values of $y_1^2$, $y_2^2$ and $y_1 y_2$ are tabulated. When, as is generally the case, the section, for example, $AB$ crosses the normal, it is divided into two sections $AA_1$ and $A_1B$. Then the distances $y_2$ for both $AA_1$ and $A_1B$ are zero, and in the tabulation $y_2^2$ and $y_1 y_2$ are both zero. The lengths of $AA_1$ and $A_1B$ are proportional to the $y_1$ distances. Then $(L/3)(y_1^2 + y_2^2 + y_1 y_2)$ is the bending flexibility index, $k_{bb}$.

The angle $\alpha$ which the length $L$ makes with the line of action need not be determined in degrees. The functions of the sine and cosine, however, are determined from the $y_1$ distances shown in Fig. 3. Thus, sin $\alpha$ of $AB$

$$\frac{(y_1 \text{ of } AA_1) + (y_1 \text{ of } A_1B)}{(L \text{ of } AB)}$$

This value squared is $\sin^2 \alpha$. Then $\cos^2 \alpha = 1 - \sin^2 \alpha$.

Since $F/EI$ is common to all sections, the sum of $k_{bb}$ of all of the sections multiplied by $F/EI$ is the total of the deflections due to primary bending:

$$\Sigma \Delta_{1} = (F/EI) \Sigma k_{bb}$$

Similarly

$$\Sigma \Delta_{2} = (F/GJ) \Sigma (\sin^2 \alpha\, k_t)$$

And

$$\Sigma \Delta_{3} = (F/EI) \Sigma (\cos^2 \alpha\, k_t)$$

## Computation of Stress

The stress at any point may then be determined from the bending and torsional moments. The primary and secondary moments are always at right angles to each other. The primary bending moment is $M_1 = Fy$; the secondary, $M_2 = \cos \alpha\, x$.

The resulting moment is

$$M = \sqrt{M_1^2 + M_2^2}$$

The bending stress is

$$S_b = \frac{M}{C}$$

The longitudinal stress due to pressure is

$$S_p = \frac{P\,d^2}{D^2 - d^2} \text{ or } \frac{PA_{\text{interval}}}{A_{\text{metal}}}$$

The total tensile stress is

$$S = S_b + S_p$$

The torsional stress is

$$S_t = \frac{F \sin \alpha\, r}{2C}$$

The maximum combined stress is

$$S_{max} = \frac{S}{2} + \sqrt{S_t^2 + \left(\frac{S}{2}\right)^2}$$

## Single Plane Problems

Pipe lines which lie in one plane require the location of the line of action. A drawing is made, Fig. 1, showing this line passing through the center of gravity of the pipe line. The $k_{bb}$ values of all the straight sections are calculated using the formula,

$$k_{bb} = \frac{L}{3}(y_1^2 + y_2^2 + y_1 y_2)$$

$$K = \Sigma k_{bb}$$

The total deflection is calculated as the product of the coefficient of expansion, temperature range and the length between the fixed ends.

The force developed may be calculated from the formula,

$$F = \frac{\Delta EI}{K}$$

The stress at any point is

$$S_b = \frac{Fy}{C}$$

Then $S = S_b + S_t$.

The maximum stress occurs where $y$ is greatest. Valves and fittings, and also cold spring joints, should be located close to the line of action, where the stress is at a minimum.

## Practical Flexibility Suggestions

Referring to Fig. 3, it appears that the maximum stresses occur at the ends of the pipe bend, $A$ and $H$. At $A$ the bending stress is 13,800, torsional 1650, combined 14,000. At

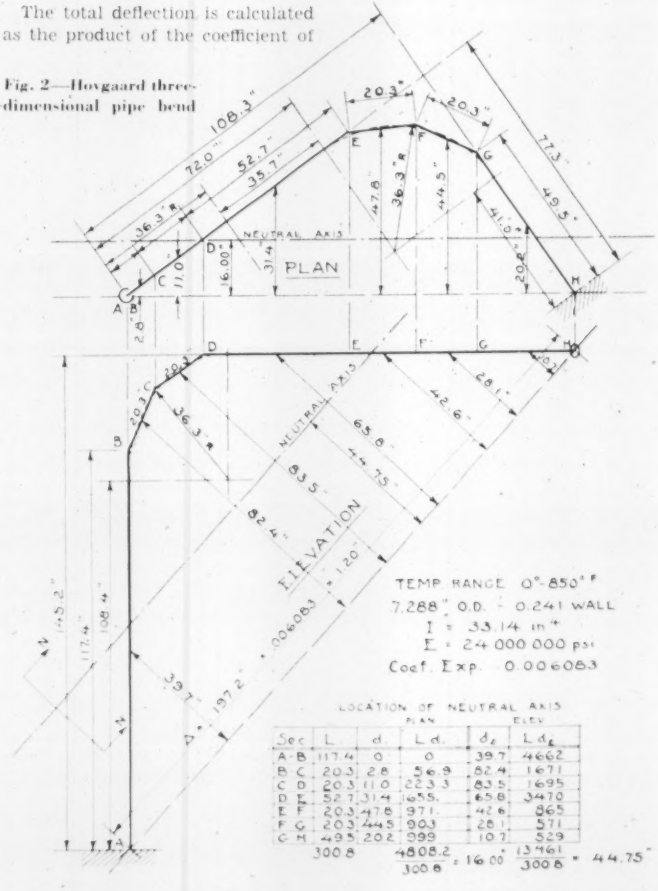
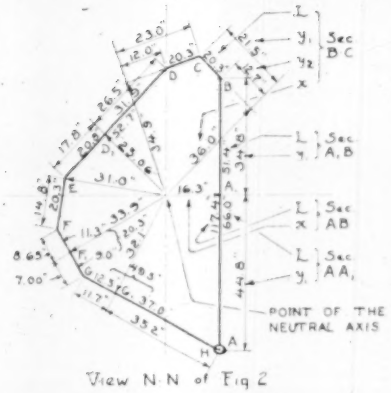



**Fig. 2—Hovgaard three-dimensional pipe bend**




View N-N of Fig 2

TEMP RANGE 0° - 850° F

$\Delta_{AH}$ = 197.2" x 0.006083 x 1.20"

PIPE 7.288" o.d. - 0.241 wall

I = 33.14 in.⁴ E = 24 000 000

Poissons Ratio λ = 0.32

$E_s = \frac{E}{2(1+\lambda)}$ = 9 090 000

$E_s I$ = 795 360 000

$E_s J$ = 602 485 000

FLEXIBILITY IN TORSION

| Sec | x | $x^2$ | L | $Lx^2 \div k_t$ |
|---|---|---|---|---|
| A B | 16.3 | 265.7 | 117.4 | 31 193 |
| B C | 36.0 | 1296.0 | 20.3 | 26 310 |
| C D | 34.9 | 1218.0 | 20.3 | 24 725 |
| D E | 25.06 | 628.0 | 52.7 | 33 096 |
| E F | 31.0 | 961.0 | 20.3 | 19 508 |
| F G | 33.9 | 1149.2 | 20.3 | 23 329 |
| G H | 32.1 | 1030.4 | 49.5 | 51 005 |

$K_T$ = 209 200

FLEXIBILITY OF SECTIONS IN BENDING

| Sec | $y_1$ | $y_2$ | $y_1^2$ | $y_2^2$ | $y_1 y_2$ | $y_1^2 + y_2^2 + y_1 y_2$ | L | $\frac{L}{3}(y_1^2+y_2^2+y_1y_2) \div k_B$ | |
|---|---|---|---|---|---|---|---|---|---|
| A A | 44.8 | 0 | 2007 | 0 | 0 | 2 007 | 66.0 | 44 154 | |
| A B | 34.8 | 0 | 1211 | 0 | 0 | 1 211 | 51.4 | 20 749 | 64 903 |
| B C | 21.5 | 12.7 | 462 | 161 | 273 | 896 | 20.3 | 6 063 | 6 063 |
| C D | 23.0 | 12.0 | 529 | 144 | 276 | 949 | 20.3 | 6 422 | 6 422 |
| D D | 26.5 | 0 | 702 | 0 | 0 | 702 | 31.9 | 7 465 | |
| D E | 17.8 | 0 | 317 | 0 | 0 | 317 | 20.8 | 2 198 | 9 663 |
| E F | 14.8 | 0 | 219 | 0 | 0 | 219 | 20.3 | 1 482 | 1 482 |
| F F | 8.65 | 0 | 75 | 0 | 0 | 75 | 11.3 | 283 | |
| F G | 7.0 | 0 | 49 | 0 | 0 | 49 | 9.0 | 147 | 430 |
| G G | 11.7 | 0 | 137 | 0 | 0 | 137 | 12.5 | 571 | |
| G H | 35.2 | 0 | 1239 | 0 | 0 | 1 239 | 37.0 | 15 281 | 15 852 |

$K_B$ = 104 815

DEFLECTIONS OF SECTIONS WITH A FORCE OF 1000 LB.

| Sec | $y_1 - y_2$ | $\frac{\sin\alpha = y_1 - y_2}{L}$ | $\sin^2\alpha$ | $\cos^2\alpha \times \frac{1}{1-\sin^2\alpha}$ | $\sin^2\alpha\, k_T$ | $\cos^2\alpha\, k_T$ | $\Delta_B = \frac{1000\, k_B}{EI}$ | $\Delta_{B_2}\cos\alpha\cos\alpha + \Delta_T \sin\alpha \times \frac{1000\cos^2\alpha\, k_T}{EI}$ | $\frac{1000\sin^2\alpha\, k_T}{E_s J}$ | Δ Total per 1000 Lb |
|---|---|---|---|---|---|---|---|---|---|---|
| A B | 79.6 | .67802 | .45971 | .54029 | .14340 | .16853 | .08160 | .02119 | .02380 | .12659 |
| B C | 8.8 | .43350 | .18792 | .81208 | .4944 | .21366 | .00762 | .02686 | .00821 | .04269 |
| C D | 11.0 | .54187 | .29362 | .70638 | .7260 | .17465 | .00808 | .02196 | .01205 | .04209 |
| D E | 44.3 | .84061 | .70663 | .29337 | .23387 | .9709 | .01215 | .01221 | .03882 | .06318 |
| E F | 14.8 | .72906 | .53153 | .46847 | .10369 | .9139 | .00186 | .01149 | .01721 | .03056 |
| F G | 15.65 | .77094 | .59435 | .40565 | .13866 | .9463 | .00055 | .01190 | .02301 | .03546 |
| G H | 46.9 | .94747 | .89770 | .10230 | .45787 | .5218 | .01993 | .00656 | .07600 | .10249 |
| | | | | | | | .13179 | .11217 | .19910 | .44306 |

Calculation of stress at A

$M_1 = F_y = 2709 \times 44.8$ = 121360 in lb

$M_2 = F \cos\alpha \times = 2709 \times 73503 \times 16.3 \div 32500$ = " "

$M = \sqrt{M_1^2 + M_2^2}$ = $\sqrt{15783 \times 10^4}$ = 125630 " "

$S_B = \frac{M}{I} \frac{D}{2}$ = $\frac{125630 \times 7.288}{33.14 \div 2}$ = 13800 lb/in²

$S_T = \frac{F_s \sin\alpha \times D}{J} \frac{2709 \times .670 \times 16.3 \times 7.288}{66.28 \div 2}$ = 1650 " "

$F = \frac{1.20}{.443} \times 1000 = 2709$ LB.

$S_{max} = \frac{S_B}{2} + \sqrt{S_T^2 + \frac{S_B}{2}^2}$ =

6900 + $\sqrt{1650^2 + 6900^2}$ = 14 000 lb/in²

**Fig. 3—In the end view, normals are drawn from the point representing the line of action to each of the straight sections comprising the pipe line and these normal distances and other data are tabulated**

*H* the bending stress is 10,920, torsional 4530, combined 12,570. At *A* the bending stress is 3,570, torsional 1650, combined 4,314. These stresses are all a minimum at point *A*, and are expressed in pounds per square inch.

The tabulated deflections have an incidental purpose in that the designer can easily read the flexibility values of any of the straight line sections. As a whole, it appears that in Fig. 3 the primary bending contributes 30 percent, the secondary bending 26 percent and the torsion 44 percent of the total deflection. The torsion stress is only 36 percent of the combined stress. This leads to the general conception that torsional elements are valuable in producing a more flexible structure, while at the same time the maximum combined stress is not increased much by the introduction of torsional members.

These two problems bring out another point of design—a "Z" shape in a single plane figure has little or no stress at the ends, particularly if the two end legs are of equal length. In the Hovgaard problem, however, the ends are at the greatest distance from the neutral axis and hence they are the points of maximum stress. The point is that such third dimension figures should not be calculated on the basis of a single plane "Z" shape.

The method given here is one that can be used in the solution of most flexibility problems. It is intended primarily for a three dimension problem. When the third dimension becomes small, however, and vanishes the problem is that of a single plane. The torsion and secondary bending deflections then vanish and there remains the simple procedure of locating the line of action through the centroid of the pipe line and of calculating the flexibility index, *K*, for the various straight sections from the formula $k = (L/3)(y_1^2 + y_2^2 + y_1 y_2)$.

The force can be calculated directly from $F = (\Delta EI/K)$ and the stress at any point is the bending moment that occurs at the point under consideration divided by the section modulus of the pipe $S = Fy/C$, in which $y$ is the distance of the point from the line of action of the force *F*.

## INSTALLING ABSORPTION REFRIGERATION MACHINES

I APPRECIATE very much G. D. Winan's comments on page 72 of the June issue on my article on steam absorption refrigeration.

I would like to comment further on the vibration and noise problem. Although there are no moving parts in the absorption equipment itself to set up vibration, the machine does have a characteristic noise which is not too difficult to confine to the machine room. However, moving pumps from the basement to the top floor presents a noise problem that does not exist when the machinery is in the basement. The pumps and attendant piping must be so installed that noise will not travel from the machine room to occupied parts of the building.

### Don't Assume No Noise Problem

I offer the above because there is a possibility that someone may misinterpret the matter and assume that there will be no noise problem whatsoever. Of course, the noise problem is much less with the steam absorption units than it is with the centrifugal or reciprocating compressors.—H. G. GREGERSON, chief mechanical engineer, George L. Dahl, architects and engineers.

# A Useful Tool---Properly Engineered

# EVAPORATIVE COOLING

*The air introduced into an evaporatively cooled enclosure must be exhausted. This view of part of the roof of the Michelson laboratory at the U. S. Naval Ordnance Test Station, Inyokern (China Lake), Calif., shows several of the evaporative cooling units, as well as power exhausters on the high roof. (Official photograph, U. S. Navy)*

*FRANK W. S. HUTTON, senior mechanical engineer, U. S. Naval Ordnance Test Station, Invokern, Calif., stresses the need for competent engineering and good installation of evaporative cooling installations, says that "the time is ripe for evaporative cooling to assume an important place as one of the 'tools' of the air conditioning engineer." He explains details of design and application of this type of equipment, basing his observations on installations handling a total of some 20 million cfm of air*

EVAPORATIVE COOLING—the term—is an anomaly, inasmuch as the process is adiabatic and therefore does not actually remove heat from the air. However, evaporative cooling—properly used—does reduce the dry bulb temperature of air and does provide comfortable and healthful living and working conditions.

The discovery of evaporative cooling is lost in antiquity. The fact that shallow pans presenting large surfaces of water to the evaporating influence of passing breezes provide cool water has been known for centuries. Porous clay vessels for drinking water are and have been used in hot climates for many years, and it was learned long ago that a dampened mat hung from the ceiling and operated to fan the air can provide more comfort than a dry one. In this country, the evolution from wetted burlap covering a window toward the prevailing wind to the present efficient and highly effective systems of evaporative cooling has been rapid.

## Types of "Desert Coolers"

The simplest and most generally used form of evaporative cooling is the so-called "desert cooler." This device may consist of a housing, three sides of which are louvered panels, the fourth side having an opening which serves as the discharge of a blower, the top being plain and the bottom comprising a tank or reservoir. Each of the three louvered panels is backed up by a pad of excelsior or inorganic material. A small pump raises water from the reservoir to pipes near the top of the unit and, by means of a series of holes in the pipes, distributes water over the pads. The excess water returns to the reservoir. A blower and motor are mounted in the housing. These units are not ordinarily made in sizes larger than 10,000 cfm capacity. When they are used in large installations, a number of them are installed in multiple.

A modification of the unit de-

scribed above consists of a pad wetted by a film of water centrifugally distributed from a point in front of the center of the pad. This is not a self contained unit and requires a separate blower and motor. A housing is built to contain the blower and the number of pads and spray units required. Another modification uses a "slinger" instead of a centrifugal spray unit, a slinger being simply a high speed paddle wheel mounted in the sump below and in front of the pads. Units similar to the above comprise the bulk of so-called evaporative coolers, in the author's experience.

### Good Engineering Is Needed

Evaporative cooling is often considered to be a makeshift, something to be apologized for. This erroneous impression is not confined to the lay public but is entertained by many engineers as well.

There are many reasons for this attitude. Too many evaporative cooling systems consist of the cheapest equipment obtainable, are installed without the benefit of competent engineering, and receive the minimum of maintenance. The dress shop, drug store or restaurant owner perhaps goes to a local store and buys a desert cooler. He or one of his clerks may be handy with tools; otherwise, he hires someone to install his "air conditioner." Installation consists of mounting the unit on a window sill and running electricity and water to it. Distribution of the air is not even considered. Even the cheapest desert coolers will provide a blast of cold air quietly when the machine is new. Control consists of a switch on the wall or perhaps it is necessary to plug the electric cord into a nearby outlet. The lack of proper outlets and distribution system results in a blast of cold air through one area that is more uncomfortable than the dead air in the rest of the room. Customers soon learn to avoid these areas and automatically think of evaporative cooling as unpleasant cooling. The pads of these coolers pass dust freely, especially when dry. Furthermore, the material of which many of them are composed and the algae that form on them are subject to decay. This results in the emission of unpleasant odors. Due to cheap construction and lack of lubrication, the blower and motor become noisy. After a period of use, the unit gradually becomes less and less efficient. At the same time it passes more dust, stronger odors and louder noise.

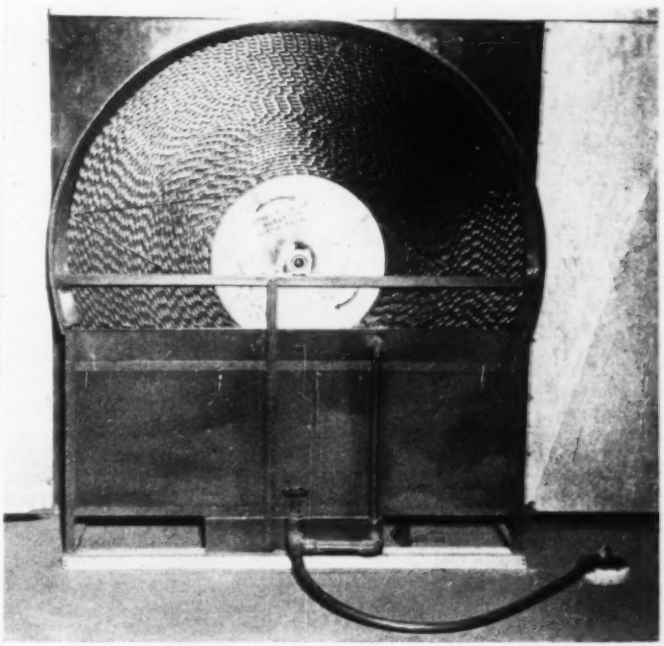
As the quality of the equipment used improves and engineering enters the picture, evaporative cooling becomes less objectionable. Pads that are arranged to prevent the growth of algae and are frequently replaced help to reduce the objectionable odors and maintain the original cooling efficiency. The pads are more uniformly wetted by various devices. Duct work and grilles or registers distribute the air without unpleasant drafts. Maintenance of the equipment by keeping belts adjusted, bearings lubricated and pads replaced all tend toward the creation of an acceptable system.

### Possibilities of Evaporative Cooling

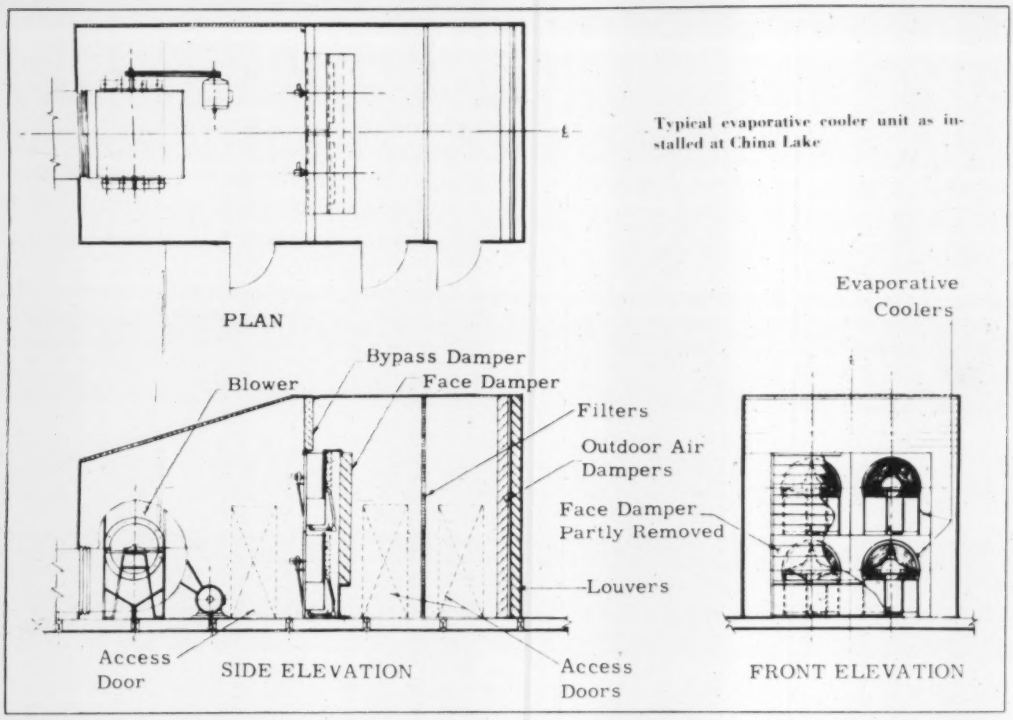
The theoretical possibilities of evaporative cooling are readily ascertained by consulting a psychrometric chart. As a hypothetical condition, let us use the outdoor design conditions obtaining at China Lake, Calif. Conditions here are more rigorous than those usually encountered. The design conditions are 110 F dry bulb and 70 F wet bulb. With these conditions, it is possible to deliver air at less than 60 F at the discharge grilles by the evaporation of water alone. This requires the use of a two stage unit. In practice we can approach the theoretically possible very closely; in fact, we can exceed it because outdoor conditions seldom reach the design conditions.

Outdoor air is passed through a water coil, the water having been cooled by evaporation to the wet bulb temperature. If the evaporative cooler and the water coil were 100 percent efficient, the air leaving the coil would be 70 F dry bulb and 57 F wet bulb. The air is then passed through a wetted surface machine and can be delivered into a room at less than 60 F. For comfort cooling in the desert, this is considerably cooler than is usually necessary or desirable.

There are places where such a two stage cooling unit is useful, just as refrigeration is necessary for satisfactory air conditioning in a large



**A rotary evaporative cooler installed at China Lake. The wheel is 46 in. in diameter and 8 in. thick, is made of alternate layers of crimped and flat metal cloth. The bottom portion is immersed in a tank of water. (Official photograph, U. S. Navy)**




Typical evaporative cooler unit as installed at China Lake

part of the world. Here at China Lake, we do not find the two stage method necessary. For instance, in a crowded grocery store with considerable emission of heat from electric lights, active shoppers and clerks—and a sun load almost unequalled elsewhere—we maintain a temperature of 80 F when the outdoor temperature is at design conditions. We do this using a single stage evaporative cooling system. It is believed that satisfactory comfort cooling can be achieved by evaporative cooling at most locations where the design wet bulb temperature is 75 F or lower. Process or product air conditioning is often a different matter. At China Lake, where our evaporative coolers handle air volumes totaling about 20 million cfm, we also find it necessary to employ more than 5000 hp of refrigeration.

### Determining the Air Quantity

Satisfactory evaporative cooling can be accomplished only by employing sound engineering and good equipment. The heat gain is determined in the conventional manner. The amount of air to be introduced is established from the formula $W = H \div [60 \times (T_i - T_s) \times 0.24]$, where $W$ = weight of air delivered, lb per min; $T_i$ = indoor design temperature; $T_s$ = temperature at grilles or diffusers; $H$ = total heat gain, Btu per hr; 0.24 = specific heat of air, Btu per lb per deg.

$T_s$ may be assumed to be the outdoor wet bulb temperature plus 10 percent of the wet bulb depression; that is, the difference between the outdoor dry bulb and wet bulb temperatures. At China Lake, $T_s = 70 + 0.10\ (110 - 70) = 74$ F.

Duct design and blower selection are the same as in any air conditioning system. However, due to the large volumes of air handled, air distribution and outlet design are most important.

The air introduced into an evaporatively cooled enclosure must be exhausted. Considerable care and judgment must be used in sizing and spotting exhaust grilles and roof vents. The roof vents should be placed as far as practicable from the inlets and down wind with reference to the prevailing wind direction.

Our experience with large structures has indicated the advisability of using a number of units of approximately 24,000 cfm capacity each. With this arrangement, machinery housings and ducts are not unduly large and cumbersome.

### No System Better Than Its Controls

No air conditioning system is better than its controls. Where practicable, we favor modulating control of the dampers. Where the cost of such control seems too high, a thermostat to control the pump delivering water to the pads is used.

This results in much less critical control and as the pads dry very quickly, hot dry air is introduced into the enclosure—causing overswings on the off cycle. This condition can be almost entirely overcome by using a rotary evaporative cooler, where the thermostat is employed to control the solenoid valves in the water supply and drain system of the cooler. The tank drains slowly and the surface of the wetted element dries progressively from the center toward the periphery, allowing a gradually increasing amount of warm dry air to be mixed into the air stream. This system approx-

imates the results obtained through the use of modulating damper control.

### Where Evaporative Cooling Is Used

Where climatic conditions are such that evaporative cooling is feasible, and the requirements are such that a central plant is indicated, evaporative cooling has many possible advantages that should be given careful consideration, including first cost, maintenance cost, power requirements and water consumption.

The high indoor humidity and the fact that no air is recirculated provides comfortable and healthful conditions in an evaporatively cooled structure. Vegetables show less wilting and meat less shrinkage in markets that are evaporatively cooled. There are many places, such as hospital operating rooms, where the higher relative humidity aids in preventing dangerous sparks from static electricity. Evaporative cooling is the only practicable means of handling certain chemical laboratories, darkrooms, explosive processing plants, etc. Many places, due to the toxicity or other hazardous quality of fumes, have much higher ventilation requirements than normal. We have many buildings where safety considerations require a complete air change every minute.

This article is not intended to be an apology for evaporative cooling. Neither does it advocate that evaporative cooling should supplant refrigerated air conditioning. Its function will have been performed if it sheds a little light on a much misunderstood subject and stimulates thought, discussion and even controversy. The time is ripe for evaporative cooling to assume an important place as one of the "tools" of the air conditioning engineer.

The engineer who is worth his salt uses available materials and methods to the best of his ability and in his client's best interests. There are large areas in which it is impossible to justify the use of any other form of cooling than evaporative for many applications. This is the considered opinion of the author, who practiced air conditioning for 15 years on the East Coast and five years in Panama before coming to China Lake.

## NOVEL INSULATION PREVENTS FREEZING, OVERHEATING

A SINGLE INGENIOUS application of mineral wool insulation at a chemical plant is serving simultaneously to guard against freezing and prevent overheating in process lines, and to control heat loss in a steam line.

Generally, when the contents of an outdoor process line must be kept from freezing, a steam line is run parallel to it and the two lines are insulated within one insulation covering. The steam line heats the process line, the insulation provides protection from extreme temperature variations due to weather, and freezing during the winter is eliminated.

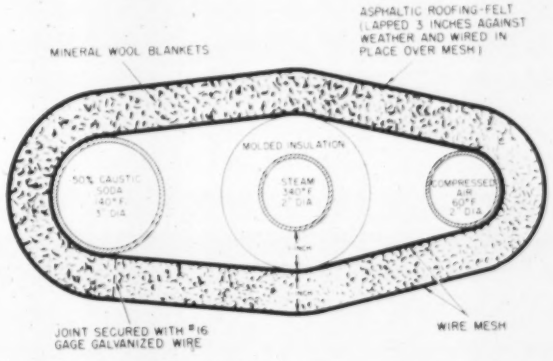
However, when the Stauffer Chemical Co., Niagara Falls, N. Y., planned to apply this technique and make use of a 340 F steam line carrying steam to interplant processes, it was found that the steam line would overheat the process lines. (In this case there were two process lines—a caustic soda line and a compressed air line.)

The common-sense solution was to insulate the steam line to a thickness which would permit escape of only enough heat to prevent freezing of the caustic soda and the moisture in the compressed air. This was done, with the result that, when the pipe-trio was encased in an overall covering of mineral wool, the process lines were prevented both from freezing and overheating. Further, the steam line was sufficiently insulated by the double layer to prevent heat from wasting to the atmosphere. Overheating of the process lines during the summer was also prevented by this technique.

The insulation technique used in this type of application is indicated in the drawing. First, after removing extraneous material such as grease and dust from the pipes, 1 in. molded sectional pipe insulation is applied over the entire surface of the 2 in. steam pipe with the sections tightly butted together and held in place by metal bands.

Second, mineral wool blankets, sandwiched between facings of wire mesh, are cut and shaped around the three pipe lines. The blankets are then wired in place with 16 ga galvanized wire. Abutting ends and edges of the blankets are tightly laced together with 16 ga galvanized wire woven into the mesh coverings. To complete the outdoor installation, asphaltic roofing felt is wrapped around the entire surface, lapped 3 in. against the weather and bound on approximately 6 in. centers by galvanized wires wrapped around the felt and tightly secured.

Engineered insulation techniques such as this one can be profitably applied to outdoor piping systems in chemical, petroleum and manufacturing industries where continuous operation must be maintained under all weather conditions, according to the Industrial Mineral Wool Institute.


ASPHALTIC ROOFING-FELT (LAPPED 3 INCHES AGAINST WEATHER AND WIRED IN PLACE OVER MESH)
MINERAL WOOL BLANKETS
MOLDED INSULATION
50% CAUSTIC SODA 140°F 3" DIA
STEAM 340°F 2" DIA
COMPRESSED AIR 70°F 2" DIA
JOINT SECURED WITH #16 GAGE GALVANIZED WIRE
WIRE MESH

INSULATION-WITHIN-INSULATION ON PARALLEL OUTDOOR PIPE LINES

# New Pumping and Piping System for Abrasive Industrial Waste Eliminates Pollution of River

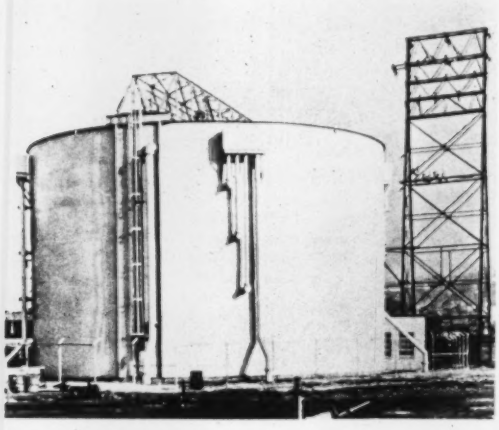
*PAUL D. OESTERLE, application engineer, Dravo Corp., describes how one industrial plant has met the problem of avoiding stream pollution by a new pumping and piping installation for disposing of highly abrasive waste resulting from the grinding and polishing of plate glass, which waste was formerly allowed to flow into the Allegheny river. The waste now goes to a thickener unit, from which clear water flows to the river. The slurry is pumped through a mile-long pipe line over a 320 ft hill to a settling basin formed by damming a natural hollow*

HOW TO DISPOSE of several hundred tons daily of a highly abrasive waste product that results from the grinding and polishing of plate glass confronted the Creighton, Pa., plant of the Pittsburgh Plate Glass Co. in its program of cooperation to clean up Pennsylvania's streams. The process creates several thousand gpm of a water mixture of powdered glass, fine silica sand, emery, rouges, plaster of paris, and a small amount of powdered iron. Until early last summer, this was allowed to flow from the plant into the Allegheny river, from which it was dredged periodically and loaded into barges for disposal.

Now, only crystal-clear water flows from the plant into the Allegheny, while the abrasive solids are pumped into a specially built lagoon a mile from the plant. A thickener was installed into which is pumped the abrasive water from the plant's industrial sewer. After passing through this unit, the water has a turbidity of less than 100 parts per million. This clear water flows into the Allegheny, while the underflow from the bottom of the thickener, a slurry with a concentration of one-third abrasive materials, is pumped through a mile-long pipe line, over a 320 ft hill, and into a settling basin formed by damming a 700 x 1600 ft natural hollow. The total clear water head overcome on the system is equal to

**Fine silica sand, emery, rouge and plaster of paris are the waste products to be disposed of after the grinding and polishing operations at the Creighton, Pa., plant of the Pittsburgh Plate Glass Co.**

**The solids settle to the bottom in this thickener. The clear water overflows into the river while the solids are pumped into a lagoon.**



530 ft. Here the solids settle out while the clear water eventually will overflow into a creek that empties into the Allegheny.

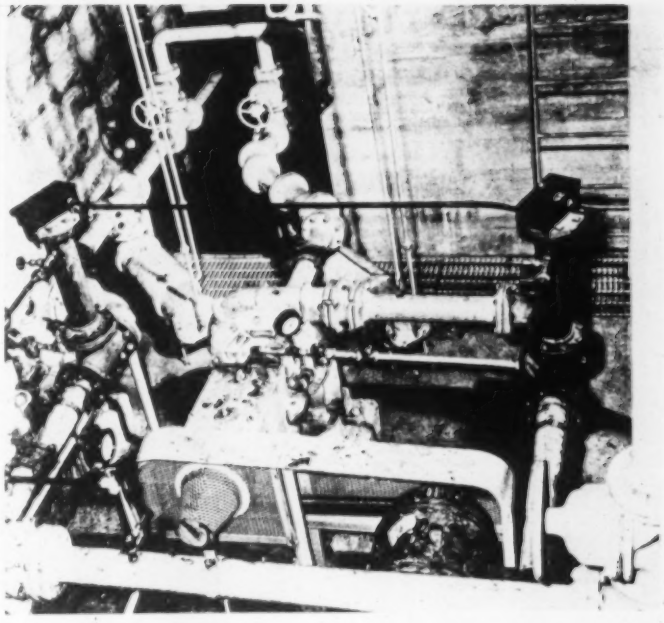
Perhaps the biggest problem in building this waste disposal system was in pumping 230 gpm of the thick, abrasive sludge over a hill to the basin a mile away. To solve it, six rubber-lined slurry pumps are used. In these pumps, all surfaces that come in contact with the solution being pumped are made of rubber to resist the abrasive action of the material handled.

The problem of leakage of the abrasive slurry into the stuffing box of this type of pump is met by introducing a very small quantity of clear, abrasive-free water into the clearances between the rotating impeller and the stationary side plate of the pump at a pressure slightly higher than the pump discharge. In this way it is impossible for the abrasive sludge to get to the stuffing box.

Two of these pumps were installed in series at the thickener, and two each, also in series, in two booster stations along the line of 4 in., extra heavy, steel pipe. All pumps, V belt drives, and motors are identical to permit the interchange of parts and to hold stocking of spare parts to a minimum.

Reversal of the flow of the sludge back through the pumps in case of a mechanical or electrical failure could cause serious damage to the system. Anticipating this possibility, a duplicate complete standby pumping system was installed to take over automatically in case of failure. In the event of a complete power failure so that the standby system could not operate, air operated dumping valves will discharge the sludge into a small emergency lagoon.

This disposal system was designed and installed by The Rust Engineering Co.



**Interior of the main pump house. Two rubber-lined slurry pumps in series handle 230 gpm of the highly abrasive slurry**

**Six pumps force the thick sludge through a mile-long pipe line, to the top of a 320 ft hill, and into the settling basin**

**The highly abrasive waste is discharged into this settling basin made by damming a natural hollow**

# *Flexural Forces on*

# PRESSURE RELIEF VALVES

*F. E. WOLOSEWICK* points out here that when pressure relief valves are used with process equipment operating at high temperatures, reacting forces from expansion of outlet piping may be considerable. He then discusses the design of such piping and gives suggestions aimed to be helpful in determining workable designs*

PRESSURE ACTUATED relief valves are used as automatic relieving devices protecting process equipment against increased pressures. They are set at predetermined pressures, within the maximum allowable working pressure of the vessel, and open wide at this point to permit fluids or vapors to be discharged. These discharged vapors or fluids may be conveyed through short vent lines to atmosphere, or may be carried by piping to suitable sumps or flares.

Short vent lines leading directly to atmosphere do not as a rule present any problems. The reactive forces from these lines impose nominal stresses on relief valves. However, in the case of outlet piping leading from valves, it is necessary to take into account all factors which may place more than normal loadings upon relief valves. This article will discuss certain phases of expansion of outlet piping, and the effect on relief valves.

When pressure relief valves are used with equipment operating at high temperatures, reacting forces from expansion of outlet piping may be considerable. Under sustained excessive loadings, resultant forces may distort valve bodies and internal parts, causing leakages and erratic popping. Leakages at the seat of the pressure retaining disk, if allowed to continue, would render the valve inoperative. Such conditions cannot be corrected by exerting more pressure on the disk without increasing considerably the set pressure on the valve.

Due to their construction, relief valves are able to resist limited forces from expansion of piping. As temperatures begin to increase, the various steels forming the component parts of the valve show marked behaviors differing in many instances quite radically from those under normal temperatures.

Thus, modulus of elasticity begins to decrease in a non-linear fashion, and varies for different alloys. Poisson's ratio begins to increase, and in view of small tolerances used in designs, this may be of some importance. Rates of expansions of steel are not quite linear, and these must be taken into consideration. Combining low manganese steels with stainless steels, especially when such steels are welded together, may be an invitation to unforeseen difficulties.

Although low carbon steels show a gradual increase in ultimate strength with increase in temperature, the proportional limit shows a marked reduction. This increase in ultimate strength of low carbon steels is a maximum at or about the

*Design engineer, Sargent & Lundy, engineers

**Table 1—Minimum strength in bending at inlet necks of pressure relief valves. (values are in 1000 in.-lb)**

Alloy Steel Body Valves

| Size | 700° | 750° | 800° | 850° | 900° | 950° | 1000° |
|---|---|---|---|---|---|---|---|
| 1½ x 2½ | 20 | 19 | 18 | 17 | 16 | 15 | 13 |
| 1½ x 3 | 24 | 22 | 21 | 19 | 17 | 14 | 12 |
| 2 x 3 | 28 | 26 | 24 | 22 | 20 | 16 | 15 |
| 2½ x 4 | 41 | 40 | 38 | 36 | 33 | 30 | 28 |
| 3 x 4 | 67 | 64 | 61 | 58 | 54 | 49 | 45 |
| 4 x 6 | 120 | 114 | 109 | 103 | 96 | 87 | 80 |
| 6 x 8 | 240 | 230 | 220 | 204 | 190 | 172 | 160 |

Cast Steel Body Valves

| Size | 300° | 450° | 700° | 750° | 800° |
|---|---|---|---|---|---|
| 1½ x 2 | 7 | 7 | 5 | 5 | 4 |
| 1½ x 2½ | 9 | 9 | 7 | 6 | 5 |
| 1½ x 3 | 11 | 10 | 9 | 8 | 7 |
| 2 x 3 | 16 | 15 | 13 | 12 | 11 |
| 2½ x 4 | 20 | 17 | 15 | 13 | 12 |
| 3 x 4 | 28 | 25 | 22 | 19 | 17 |
| 4 x 5 | 42 | 40 | 35 | 31 | 27 |
| 4 x 6 | 62 | 53 | 42 | 37 | 33 |
| 6 x 8 | 140 | 120 | 98 | 83 | 76 |

600 to 650 deg limit; beyond this temperature, the reduction in ultimate strength is very pronounced. Furthermore, these steels show noticeable changes in ductility. Hence, the codes—very wisely—specify a limiting stress value up to some critical temperature range, and beyond this temperature range there is a percentage reduction for specified temperature increments (See Table 1).

Although many different types of relief valves are available, this article is confined to nozzle type, spring loaded, top guided relief valves (Fig. 1). These valves are used for high pressures and high temperature services, where expansion of discharge piping presents critical problems.

Relief valves when insulated will be at the temperature of the process material. A frequent practice is to leave the insulation off the valves, and thereby take some advantage in increased body strength due to lower temperature. To the best of the author's knowledge, no theoretical or experimental data are available to indicate what the reduction in temperature should be.

The author prefers to use process temperatures for the design of relief piping, regardless of whether the valve is insulated or not. Under unusual conditions, however, this premise may result in unsatisfactory relief piping layouts, which may be difficult to support and guide. For such conditions, it would be reasonably safe to decrease the temperature by some conservative figure. In the elevated temperature ranges, a reduction of body temperature by about 100 F appears justifiable. Considerable amount of judgment and experience is necessary to apply a correct temperature reduction factor to the design of unusual relief lines.

The temperature of the outlet flanges of relief valves may be from 400 to 500 deg less than the temperature under the disk, if the valves are not insulated. Temperature of piping adjacent to the valves decreases rapidly, and within four to five pipe diameters beyond the outlet flange, wall temperatures are normal, assuming uninsulated pipe. As soon as relief valves open, discharging excess pressure, temperature on the system is less than that of the discharging material.

It is generally assumed that the temperature of relief piping is that of surrounding air, when strained by displacements of relief valves attached to pressure vessels or process lines. Forces developed by strained piping are functions of temperature difference, properties of the pipe, and flexibility of the complete piping system with its branches. Determination of forces in such systems due to displacements can be accomplished by several of the newer methods of analyses recently developed.

When relief valves discharge overpressured liquids or vapors, there is generally a reduction of differential expansion between process equipment and outlet piping, alleviating overstressed conditions. Such stress relief is of short duration.

Small sized relief valves have outlets considerably larger than inlets. As an illustration, consider a $1\frac{1}{2}$ in. x 3 in. flanged relief valve. If the outlet piping is Schedule 40, the moment of inertia is 3.0. For a $1\frac{1}{2}$ in. extra strong inlet, the moment of inertia is 0.40. The ratio of the two inertias is thus 7.5, and for a double extra strong inlet, the ratio would be about 5. Hence, the inlet must resist expansion forces of piping at least 5 to 7 times stronger. In order to prevent dangerous stresses from developing, it is therefore necessary to plan layouts of outlet piping with more than ordinary care.

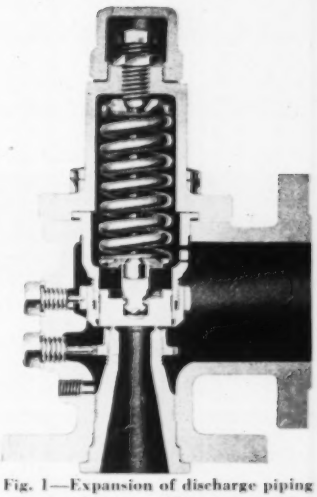


**Fig. 1—Expansion of discharge piping presents design problems when relief valves are used in high pressure, high temperature service**

Another possible source of weakness controlling the design of outlet piping are connecting ells and flange bolting. When pressure relief nozzles are horizontal, ells must be used to install relief valves vertically. Relief nozzles are generally made the same size as relief valve inlets, and carry the same flange rating.

In order to keep within allowable stress ranges, it may be necessary to reinforce the ells, use heavier rating ells, increase the diameter of

**Table 2—Moments of resistance of bolted connections (values in 1000 in.-lb). *D* = diameter of nozzle, N = number of bolts, *B.C.* = bolt circle, $S''$ = section modulus of bolts, in.[3]**

Series 15

| *D* | N&ϕ | *B.C.* | $S''$ | 600° | 700° | 800° | 900° |
|---|---|---|---|---|---|---|---|
| 2 | 4— $\frac{5}{8}$ | $4\frac{3}{4}$ | 0.96 | 14.4 | 10.2 | 7.2 | 5.2 |
| 3 | 4— $\frac{7}{8}$ | 6 | 1.21 | 18.2 | 12.8 | 9.8 | 6.5 |
| 4 | 8— $\frac{5}{8}$ | $7\frac{1}{2}$ | 3.03 | 45.2 | 32.1 | 24.5 | 16.3 |
| 6 | 8— $\frac{3}{4}$ | $9\frac{1}{2}$ | 5.75 | 86.2 | 61.0 | 46.5 | 31.0 |
| 8 | 8— $\frac{3}{4}$ | $11\frac{3}{4}$ | 7.10 | 106.5 | 75.0 | 57.5 | 38.0 |
| 10 | 12— $\frac{7}{8}$ | $14\frac{1}{4}$ | 17.9 | 269.0 | 190.0 | 145.2 | 97.0 |
| 12 | 12— $\frac{7}{8}$ | 17 | 21.3 | 319.0 | 225.0 | 172.0 | 115.0 |

Series 30

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2 | 8— $\frac{5}{8}$ | 5 | 2.02 | 30.0 | 21.4 | 16.3 | 10.7 |
| 3 | 8— $\frac{3}{4}$ | $6\frac{5}{8}$ | 4.0 | 59.9 | 42.4 | 32.3 | 21.5 |
| 4 | 8— $\frac{3}{4}$ | $8\frac{5}{8}$ | 4.76 | 71.5 | 50.5 | 38.5 | 25.7 |
| 6 | 12— $\frac{3}{4}$ | $10\frac{5}{8}$ | 9.65 | 144.7 | 102.0 | 78.0 | 52.2 |
| 8 | 12— $\frac{7}{8}$ | 13 | 16.3 | 245.0 | 173.0 | 132.0 | 88.2 |
| 10 | 16—1 | $15\frac{1}{4}$ | 33.7 | 506.0 | 357.0 | 273.0 | 182.0 |
| 12 | 16—$1\frac{1}{8}$ | $17\frac{3}{4}$ | 49.5 | 743.0 | 525.0 | 400.0 | 268.0 |

Series 60

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2 | 8— $\frac{5}{8}$ | 5 | 2.02 | 30.0 | 21.4 | 16.3 | 10.7 |
| 3 | 8— $\frac{3}{4}$ | $6\frac{5}{8}$ | 4.0 | 59.9 | 42.4 | 32.3 | 21.5 |
| 4 | 8— $\frac{7}{8}$ | $8\frac{5}{8}$ | 7.12 | 106.0 | 75.0 | 57.0 | 38.0 |
| 6 | 12—1 | $11\frac{1}{2}$ | 19.0 | 283.0 | 201.0 | 153.0 | 102.0 |
| 8 | 12—$1\frac{1}{8}$ | $13\frac{3}{4}$ | 28.6 | 429.0 | 303.0 | 231.0 | 154.0 |
| 10 | 16—$1\frac{1}{4}$ | 17 | 60.5 | 908.0 | 642.0 | 490.0 | 327.0 |
| 12 | 20—$1\frac{1}{4}$ | $19\frac{1}{4}$ | 85.5 | 1280.0 | 907.0 | 693.0 | 462.0 |

relief nozzles, or provide more flexible piping. When pressure relief nozzles are increased, reducing ells are necessary, whose strength would be greater than that of the ell of the inlet diameter of the relief valve. When a larger ell is used, a reducer is necessary and relief valve is bolted directly to the reducer. Although this provides a strong support for the valve, it is more expensive since an extra fitting is used.

In certain processes, reducers when uninsulated may cause deposition of solids to occur in the dead space under pressure relief valves. If sufficient deposition develops, relief valves may become ineffective as protecting devices.

Inlet bolting at times may be overstressed by too rigid relief piping, causing leakages. Since actual stresses in bolting cannot be determined accurately because of the complex nature of the problem, apparent moments of resistance at various temperatures, using accepted theory of flexure, were evaluated. These values serve as a useful guide in predicting permissible stress ranges, and are shown in Table 2.

Very little information is available on temperature ranges of uninsulated bolts. It appears from fragmentary observations that bolts are approximately 200 to 300 deg cooler than the process material under the disk of the relief valve. If flanges were fully insulated, the temperature of the bolting would undoubtedly approach that of the process material.

## Permissible Moments

Permissible moments on relief valves are functions of the stress at working temperature, the section modulus of the inlet neck, and a suitable multiplier, less than one, determined experimentally or evaluated analytically, which maintains tightness of the disk at operating temperatures. Generally the only force which requires consideration is the bending moment, since it tends to bend the body of the valve. Torsional moments are rarely serious, and may generally be ignored. This holds true for all direct forces—tension, compression and shear.

Permissible bending moments on the more common types of relief valves at various temperatures, for cast steel and alloy steel bodies, are shown in Table 1. In Table 3 are permissible moments on ells at various temperatures. This table applies to cast ells and welding ells with radius of curvature comparable to that of cast ells. The values indicated are at time of replacement, after corrosion and erosion. Where corrosion and erosion are not factors, the values given may be increased.

Strength of ells may be consider-

**Table 3—Minimum strength of cast steel ells in bending (values in 1000 in.-lb). *D* = diameter of nozzle, *S* = minimum section modulus at time of replacement, *β* = longitudinal stress intensification factor**

Series 15

| *D* | *S*/*β* | 650° | 700° | 750° | 800° | 850° | 900° |
|---|---|---|---|---|---|---|---|
| 2 | 0.91 | 6.3 | 6.2 | 5.7 | 5.3 | 4.8 | 3.1 |
| 2½ | 1.19 | 8.2 | 8.1 | 7.5 | 7.0 | 6.3 | 4.5 |
| 3 | 1.34 | 9.3 | 9.2 | 8.4 | 7.9 | 7.1 | 5.1 |
| 3½ | 1.53 | 10.5 | 10.4 | 9.6 | 9.0 | 8.1 | 5.8 |
| 4 | 1.27 | 8.8 | 8.6 | 8.0 | 7.5 | 6.7 | 4.8 |
| 6 | 2.7 | 18.6 | 18.4 | 17.0 | 16.0 | 14.3 | 9.5 |
| 8 | 3.85 | 26.8 | 26.2 | 24.3 | 23.0 | 20.4 | 14.6 |

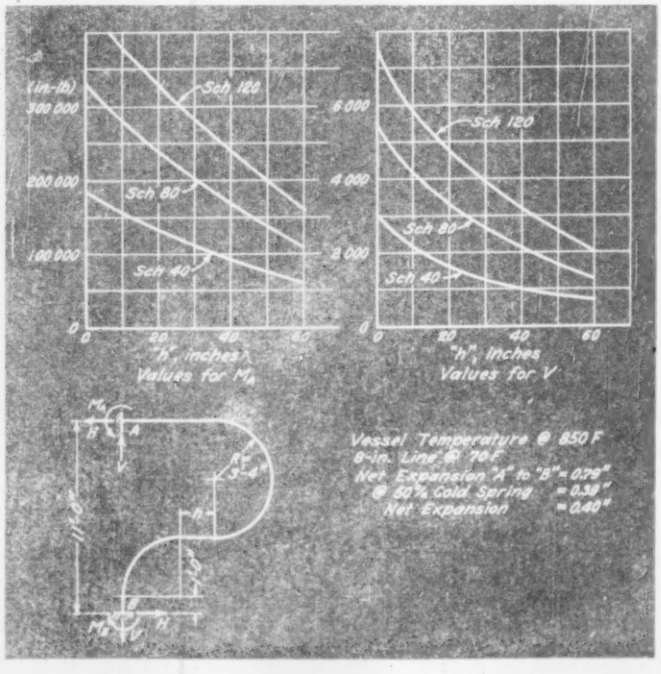
Series 30

| *D* | *S*/*β* | 650° | 700° | 750° | 800° | 850° | 900° | 950° |
|---|---|---|---|---|---|---|---|---|
| 2 | 0.91 | 6.3 | 6.2 | 5.7 | 5.3 | 4.8 | 3.1 | 2.7 |
| 2½ | 1.19 | 8.2 | 8.1 | 7.5 | 7.0 | 6.3 | 4.5 | 3.5 |
| 3 | 2.26 | 15.6 | 15.3 | 14.2 | 13.3 | 12.0 | 7.8 | 6.5 |
| 3½ | 1.92 | 13.2 | 13.0 | 12.0 | 11.3 | 10.0 | 7.0 | 5.5 |
| 4 | 2.6 | 18.0 | 17.0 | 16.0 | 14.0 | 12.0 | 9.9 | 7.8 |
| 6 | 4.72 | 30.0 | 29.0 | 27.0 | 25.0 | 23.0 | 18.0 | 14.0 |
| 8 | 7.82 | 52.0 | 50.0 | 47.0 | 44.0 | 41.0 | 30.0 | 23.0 |

Series 60

| *D* | *S*/*β* | 700° | 750° | 800° | 850° | 900° | 950° | 1000° |
|---|---|---|---|---|---|---|---|---|
| 2 | 1.17 | 10.0 | 9.0 | 8.2 | 7.3 | 6.4 | 4.7 | 1.7 |
| 2½ | 2.19 | 18.5 | 17.0 | 15.3 | 13.7 | 12.0 | 8.8 | 3.3 |
| 3 | 2.9 | 24.6 | 22.5 | 20.3 | 18.0 | 16.0 | 11.6 | 4.3 |
| 3½ | 4.6 | 39.0 | 35.6 | 32.0 | 29.0 | 25.3 | 18.4 | 6.9 |
| 4 | 6.9 | 58.5 | 53.5 | 48.0 | 43.0 | 38.0 | 27.6 | 10.3 |
| 6 | 15.3 | 130.0 | 118.5 | 107.0 | 96.0 | 84.0 | 61.0 | 23.0 |
| 8 | 26.3 | 223.0 | 204.0 | 184.0 | 164.0 | 145.0 | 105.0 | 40.0 |

**Fig. 2—Principal forces on 8 in. pressure relief**



ably increased by judicious proportioning of ribs. Although localized stresses are developed at the junction of the stiffening rib and the wall, these stresses are not always serious, and are modified by plastic flow of the metal. Stresses due to differential temperatures may reach high values, but these may be kept low by proper insulation.

Design of pressure relief piping requires a considerable amount of judgment, practical experience, and understanding of behavior of piping and process equipment at elevated temperatures. Injudicious selection of anchor points or guides can develop forces capable of distorting relief valves. Incorrect selection of the origin of expansion may cause excessive deflections of outlet piping, which may reflect in large reactive forces on relief valves and anchors. Large anchor reactions may cause localized and at times dangerous stresses in process equipment to which anchors are attached. Rough methods of calculating expansion forces and rule of thumb proportioning of expansion piping are too hazardous, especially where high temperatures and pressures are considered.

## Design Suggestions for Relief Piping

It is difficult to establish satisfactory criteria which will apply to all cases of relief piping. The following general observations are helpful in determining workable designs for the simpler types of expansion systems:

1) Anchor points should be located as close to relief valves as pipe fabrications will allow. Relief piping should be in the plane of the relief outlet.

2) Light wall piping should be used, preferably schedule 40 or 30 if the latter is available, and corrosion and erosion are not serious factors.

3) If process considerations permit, welding ells should be used and their flexibilities utilized for reducing forces on relief valves. Any bend in the line should not be more than five pipe diameters. Fig. 2 gives a comparison of forces using various wall thicknesses on a special type of relief bend.

4) In extremely difficult spots, corrugated piping should be used.

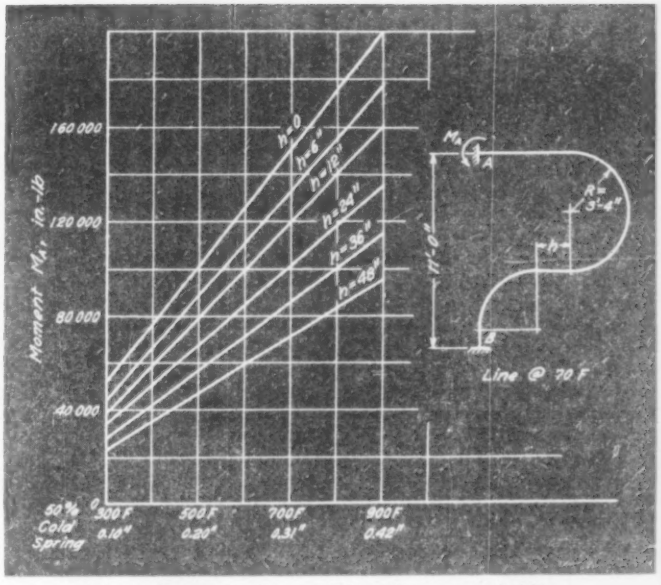



**Fig. 3—Moments in 8 in., Schedule 40 pressure relief line**

Corrugated piping should be used in vertical runs to permit drainage.

5) If relief piping is connected to long relief headers, such connections should be made as close to the header anchor point as possible.

The above "rules" are somewhat general and apply to the simpler types of piping layouts. As complexity of piping systems increase, design of pressure relief piping to satisfy weakest points at elevated temperatures becomes a difficult problem, requiring considerable analysis.

A simple type of an expansion loop which has found limited application in oil refining is indicated in Fig. 3. The valve is located at point "A," with ample strength below inlet nozzle, so that the problem is one of determining suitable length "h" to satisfy strength of the relief valve, ells or studs for any given temperature.

At any given temperature, with a 50 percent cold spring of the pressure relief line, bending moments on the relief valve may be readily determined. It is very important to provide a rigid anchor at point "B" capable of resisting 50 percent of the moments indicated at "A". Providing a strap at this point allows rotation to develop, which will reflect in large moments on the valve.

To utilize relief valves to their greatest advantage, it is desirable to design and prestrain the piping so that relief valves are free of expansion stresses when the plant is in operation. When pressure relief valves discharge excess pressures, moments on these valves, or on other critical parts, should not exceed the values given in the accompanying tables.

Prestressing relief piping 50 percent of the total expansion is a recommended practice, providing bending moments are within specified limits. This practice is satisfactory and should be used up to a maximum temperature of 750 F. Beyond that temperature range, 100 percent prestrain, if possible, is more desirable, and will give trouble-free performance of relief valves. This procedure should keep maintenance costs at a low level.

## OLDEST STORE IS AIR CONDITIONED

HAGER'S—believed to be the oldest department store in the United States on the same location and continuously operated under the same family name since 1821—at Lancaster, Pa., will be air conditioned this summer to provide greater shopping comfort and better working conditions for its employees, it has been announced by John R. Hertzler, vice president and general sales manager of York Corp.

# QUESTION of the Month

IN THIS regular feature, specific questions on heating, piping and air conditioning which have been asked by HPAC's readers are answered both for the original "asker" and for others who may be interested. The editors hope you'll find these practical comments of regular monthly interest.

## FILING TECHNICAL INFORMATION

MUCH OF THE information in technical periodicals can be put to immediate use, but it is rare for an issue not to contain at least one item which the reader wants to keep for possible future value. The average powers of memory cannot be trusted for long, unless memory can be reinforced by putting new information to early practical use. Most engineers collect manufacturers' data and copies of articles that interest them. All who do this must have pondered the problem of devising a trouble-free scheme for keeping such information so that it is easy to find, as evidenced by "S.D.B.'s" question on the matter published in the May HPAC.

On the other hand, there are those who say that it is not worthwhile keeping personal copies of journals or articles, when they can be seen at a library. Yet, library search is not very simple. And, apart from deciding where to start, what about the time involved? The job will not wait. The customer certainly will not. Unless the volume or the approximate year of publication is known, the task can be both physically and mentally fatiguing. All that is really required is the index to each volume; but, as each index is usually bound with the volume, the complete volume has to be removed from the shelf and the index found first! Even if you can instruct someone else to make the search for you, it is not quite the same thing. The assistant may miss just the one item which may resolve your difficulty.

I faced this problem nearly 20 years ago, when I already had a large collection of journals, catalogs and leaflets. Some of the journals were bound and they looked very well. Some were in neat piles. Others were originally in neat piles until the first time I wanted to find something in them. The wasted time, the dust and the irritation led me to spasmodic mutilation of journals to extract items that I knew instinctively would be needed at some later date. But, I soon realized that I was still not getting the maximum value from the wealth of up-to-date technical information made available to me by way of manufacturers' leaflets, technical publications, private communications and documented personal experience.

After some false starts, I reached some mature conclusions. Complete volumes of journals are available in a library somewhere. If the index were at hand, I could make a quick decision as to whether what I was seeking might be found in a particular journal. And I could do this with very little effort and without leaving the office. Further, by making full use of the facilities of a good library, I could have the wanted material sent me. Therefore, there was no point in keeping complete personal copies of journals.

This still left the problem of what to do with articles (or advertisements) which particularly interested me and which I knew would almost certainly be wanted later. These might be extracted and filed or a reasonable alternative—the article might be noted on a card which might then be filed under a subject index. The trouble with the card index would be that, having been reminded by it of the article I wanted and where to find it, I still had to go to the library. My conclusion was that the most convenient method would be to file the article itself, so long as a simple scheme of filing could be found which would involve little labor. I knew that unless the amount of work was very small the scheme would fail.

The system I use has worked well for many years. Its success undoubtedly lies in the original choice of a few generalized subject headings covering the whole field of my interests. Titles such as the following (taken at random) give some indication of the all-embracing nature of each of the original folders —Air: Burners: Combustion: Controls: Fuels: Heat Treatment: Heating Systems: Hot Water: Physiology: Pipe and Pipe Sizing: Ventilation: Water. The list of folder titles has now grown considerably and is today a very long one. It would have no real value to anyone else.

I have never bothered to plan subdivisions of these main titles. The file has grown almost automatically. For instance, in the folder originally labelled controls was placed everything relating to automatic or manual controls, whatever the fuel or purpose. It embraced thermostats and pressurestats of all kinds, control valves (whether manually, electrically or pneumatically operated), flame failure controls and control systems generally. The folder soon became unwieldy and the first time it was necessary to refer to all the data on one type of control, the material had to be extracted and I automatically made a separate folder with a subtitle. Thus, the information file grew.

Leaflets, catalogs, reports and articles all go in the same file, so that if the available information on one subject is wanted it can be got by one plunge of the hand; the theory and practice together, the 'how' and the 'why' as well as the manufactured apparatus associated with the subject.

It is my good fortune to have someone do the practical but important job of inserting the pieces of paper in the right folder. I decide where they are to go by writing the name of the folder at the top of the sheet (which is not so simple as it sounds). I will not begin a fresh subject folder if that can possibly be avoided. I keep a list of the folder titles by me when marking up material for filing, and if a new subject folder becomes

essential, I add this title to the list and indicate on the material to be filed that a new subject has been opened.

There is always difficulty when parts of two useful articles occur on the same page. My present practice is to file one article complete and to make a note at the end of the other—the incomplete one—where the rest of the article may be found. This is anything but ideal. Whoever prefers the direct method of filing individual articles, as I do, will be grateful to editors who do not mix the end of one important article with the beginning of another on the same sheet.

Occasionally I scribble a note giving reference to an article or a book which I have seen, but which I do not possess. Here, it is best to use a whole sheet, even if the note is only a couple of lines, for smaller pieces of paper hide themselves so easily. But, there is no system here. In fact, I avoid any outward semblance of a system. When my file began, there was a real system, with a real card index and cross-references to glorify it, until it became obvious that the system had begun to run me. What is left of the original scheme works very well and I doubt whether I spend more than a couple of hours each month in keeping it going.

In my early enthusiasm, I collected much that was not of permanent value and a purge is long overdue, but I refuse to undertake any major task connected with my information file. It has to work for me now. I am, however, constantly throwing out old and useless material—although no material is discarded just because it is old.

I am proud of my information file. It is a joy to use. The ease of reference to acknowledged masters of their subjects, to the published experience of others, to new facts which may not appear in book form for years, all these give reinforcement to one's confidence in the face of new problems.—W. F. MOORE.

## ITEMS ARE FILED ALPHABETICALLY BY SOURCE

THE QUESTION from "S.B.D." on page 70 of the May HPAC asked for suggestions on filing articles, other published material and miscellaneous data on heating, piping, and air conditioning.

There are almost as many variations in filing systems as there are interests of the users. I have tried the Dewey decimal system but found it did not fit my needs. Now, I use a system which to some extent resembles the index to the Guide of the ASHVE, but is wider in that I use more classifications for building materials and methods.

First, all individual pamphlets and items are indexed alphabetically according to source, such as IBR, U. of Ill., U. of Minn., U. of Wis., etc. and the items are so filed. Magazines are filed by dates.

Second, a subject index on 3 x 5 cards is compiled. General headings include Structural—Insulation—Condensation—Heat Transfer—Fluid Flow—Fuels—Panel Heating—Combustion—Heat Pump—Applications—etc. Each of these has probably from five to ten subdivisions.

Any individual item is indexed under all subdivisions which apply. As an example, Panel Heat has such subheadings as Forced Air, Design, Floor, Ceiling and Snow Melting. Heat Pump has Air Heat Source, Well Water, Ground Coil, Test Data, and Coefficient of Performance subheads.

There are almost 400 subdivisions in my file. The accompanying card is a sample, and shows one of the cards from my Heat Pump file.—GEORGE J. SCHACHEL, refrigeration service.

Sample of index card used by Mr. Schachel

| | |
|---|---|
| HPAC | by G. D. Wetherbee |
| 9/49 | Heating with the Heat Pump<br>Equipment Details, Operating Results |
| 6/49 | Operating Data on Heat Pump Shows<br>Application of Method |
| 12/49 | Analysis of Heat Losses and Operation |
| 6/49<br>(Journ) | Country's Largest Heat Pump Was Unperturbed<br>in Record Cold Spell |
| 9/49<br>(Journ) | Thermodynamic Criteria for Heat Pump<br>Performance by John Sandfort (Iowa State) |

## FILES DATA IN RING BINDERS

IN ANSWER TO the question from "S.D.B." on filing articles and technical data, published on page 70 of the May issue of HPAC, I suggest the following scheme, which I use.

It will be found extremely useful to remove the factual matter from magazines and file this material in a three-ring binder. By just retaining the "meat", a full year can be very well filed in one hard covered binder. At the front of this particular binder one might place the 12 monthly indices of the periodical in question. In addition, a 3 x 5 card index arranged alphabetically for the various subjects should be kept up-to-date. Then, when the annual index has been prepared by the publisher of the magazine, a copy should be placed in the front of the binder.

With this particular index and the card index, it should be an easy matter to locate within a very few moments any reference data which have appeared in any of the volumes of the magazine.—F. W. TAYLOR, chapter engineer, Canadian chapter, National Warm Air Heating and Air Conditioning Association.

* * * * *

*If you have a question on heating, piping or air conditioning which you'd like to have answered by HPAC's readers, send it to the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, for possible publication . . . You are also invited to submit answers to published questions, which are printed (space permitting) for the benefit of all. Such a question appears on page 109 this month.*

# Sam Lewis' Page

## *Reader Asks for Advice on Heating Factory Buildings*

**INFORMAL comment on heating, piping, and air conditioning matters is given in this regular monthly feature by Samuel R. Lewis, consulting mechanical engineer and member of HPAC's board of consulting-contributing editors**

A READER OF HPAC (a subscriber for many years) who has recently been placed in charge of a heating system serving some 7 million cu ft of connected factory buildings has written the editor, asking some arresting questions. The editor has passed these questions along to me, the idea being to kill two birds with one stone: Get answers for the questions, and copy for this month's Sam Lewis' Page.

The factory buildings vary from one story to six stories in height, and some important assembling is done by women who work at long benches near outside walls.

Apparently, the plant is in a vigorous climate and the buildings are heated by direct steam radiators and pipe coils. Two years ago, some 26 zone control valves were placed on the steam mains. These valves are of on-off type; that is, each is either wide open or closed. Each is operated by electric energy coming through an unstated number of thermostats, placed out-of-doors and presumed to be in the effective orientations as to sun and wind.

If the outdoor thermostat for any particular zone demands heat, steam is turned on. It is not stated by the questioner how the steam gets turned off, except that a hint is given that each zone thermostat may do so on a timed cycle regardless of temperature. This seems to imply that the outdoor thermostat, if cold, requested a full shot of steam and then after an interval, closed the valve, hoping that the steam was available, and that enough time had passed for it to reach each radiator and to force out the air. There is a high pressure steam main reaching several outlying pressure reducing valves.

The heat transmitters in the various buildings vary from cast iron radiators to long pipe coils suspended below windows. A single steam driven reciprocating vacuum pump near the boilers is expected to care for the condensate and air returning through extensive old mains which are at varying elevations relative to the vacuum pump elevation.

### These Questions Are Asked

The questions asked are as follows:

"1) Am I likely to run into trouble with wall coils that are 125 ft long when I attempt to heat them on an intermittent cycle, especially as the women assemblers down near the return ends of such coils must be kept comfortable?

"2) How large an area can be operated satisfactorily on a gravity condensation return system?

"3) Can I be expected to maintain subatmospheric pressure in the return mains of such a large system with several hundred radiator valve stems, many suction lifts and with these intermittent deliveries of steam?

"4) Why should I not abandon the vacuum pump and substitute operation at higher than atmospheric pressure, with gravity returns to the condensate pump?

"5) Is there some rule that if a steam heating system has more than 10,000 sq ft of radiation, a vacuum pump must be employed?"

It would be easier to answer these questions by writing an essay on steam heating systems for factories, but specific replies are requested.

### These Are My Answers

*Answer No. 1*—An intermittent cycle thermostatic control should have the thermostat inside the room, where it knows something about average conditions affecting the people.

A simple outdoor thermostat may serve an entire apartment building more effectively than can a single indoor thermostat; this is true because rarely can we find an interior location in an apartment building that gives an average temperature sample. There are hundreds of acceptable temperature control jobs where the outdoor thermostat (a) works in cooperation with an indoor thermostat (b) often clamped against the end of the return main. If thermostat (a) is satisfied and would shut off the heat, thermostat (b) properly adjusted, will think that maybe (a) soon will ask for heat, so (b) will keep a little heat ready to serve and thus will prevent the folks from being disappointed.

Question No. 1 is inspired by a plant where there is no thermostat

(b) and my answer is that it is reasonably certain that the long wall coils, with the control method now in effect, will be heated quickly at the steam supply ends and may never receive enough steam to keep the occupants limber and effective near the return ends of the coils.

*Answer No. 2*—There is a limit to the area that can be operated satisfactorily on a gravity return. The answer does *not* depend upon size, however. To operate a gravity return steam heating system, the steam pressure must be high enough above atmospheric to force out the air. To do this trick, every heat transmitter must have a valve discharging to the air and differentiating between steam, and condensed steam and air. It should prevent any entry of air. The heat transmitter that is served by such a valve must take an appreciable time to get warm after the steam valve is opened. If the supply of steam is intermittent, the pressure in the heat transmitters, between cycles, will fall below atmospheric and condensate cannot be discharged unless air is admitted above the condensate. Just try to drink liquid out of a bottle without admitting air above the liquid!

*Answer No. 3*—You cannot be expected to maintain consistent subatmospheric pressure in the particular system described. It would be judicious to make the following changes: Pack the radiator valve stems if they are aggressively leaky. Install several outlying local vacuum pumps in strategic locations, discharging to a new separate pressure return main. By no means ever try to discharge the condensate from one vacuum pump into the suction main of any other vacuum pump. If there must be any high suction lifts, be sure that they are in successive small increments. A vacuum pump will care for a surprisingly large number of little air inleaks such as occur at valve stems. Remember that every heat transmitter and other point of communication between the steam side and the return side must have a trap, and that these traps should be inspected and cleaned occasionally.

*Answer No. 4*—You can find practically no steam heating plants that have been changed from vacuum operation back to operation at higher than atmospheric pressure. There are thousands of plants that have been changed the other way, and have gained in efficiency and saved fuel due to the change.

*Answer No. 5*—There is no rule that a vacuum pump must be used on a heating plant having more than 10,000 sq ft of radiation. If I were to design a steam heating system even as small as 500 sq ft, I would be likely to use a vacuum pump and I have designed such systems of 1,000,000 sq ft and I surely did employ many vacuum pumps, each at a reasonably sized outlying load center.

In conclusion, a good sized receiver should be installed in the boiler room, to which the various outlying relatively small vacuum pumps may deliver the condensate at slightly higher than atmospheric pressure. A boiler feed pump, preferably in connection with a deaerating feedwater heater, should deliver the water to the boilers.

The outside thermostats should be coordinated with indoor thermostats, and of course the heat transmitting power in each building and room must be commensurate with the respective heat demand. The capacity of the steam and return piping and that of the pressure reducing valves also must be intelligently adjusted.

## ASKS FOR HELP ON AN OPERATING PROBLEM

YOU ARE INVITED *to answer the following question which has been asked by a reader of HPAC. Suitable comment on the matter will be welcomed and—space permitting—will be published. Suitable sketches or photos are particularly desired. Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.*

*"In one of our air conditioned buildings, we have a problem which has defied the best efforts and ideas of everyone concerned. Perhaps through the medium of the Question of the Month columns, I can get a workable solution to this very troublesome condition.*

*"This building is served by two air conditioning systems of 200 tons capacity each. Each system is identical and consists of a flooded chiller, superheater, two 100 ton compressors arranged to give four steps of capacity, and two evaporative condensers. All of this equipment, together with the water and "Freon" piping, is installed according to good practice and is adequately sized.*

*"The systems were first put into service last summer, and ever since then we have been bothered by the compressors losing their oil pressure and shutting down. This is apparently caused by two things: (1) the oil is actually carried out of the crankcase by the "Freon" or (2) the oil is diluted by the "Freon" to the point that the oil pressure drops below a minimum operating point.*

*"Both compressors have oil separators and there is an oil return from the chiller. Another confusing factor is that one compressor may shut down on low oil pressure while its mate on the same system will continue to run; then again, both of them will shut down.*

*"Any suggestions will certainly be appreciated."—R. A.*

# *Inspection and Testing of*

# WELDED PIPING

*INSPECTION and testing of welded pipe joints provides assurance that the work meets the purchaser's specifications and the requirements of the applicable codes governing it. Involved are preliminary inspection, visual inspection of work in progress, non-destructive tests of various kinds, destructive tests of selected joints, hydrostatic tests and service tests. These are outlined here, with suggestions for conducting them and notes on their importance*

THE PURPOSE OF inspecting and testing welded pipe joints is to provide assurance that the work meets the purchaser's specifications, and that work which is within the scope of a mandatory code complies with the requirements of that code. It is generally accepted that such assurance can be obtained by: (1) The use of a welding procedure that has been proved satisfactory. (2) Control of all operations to make certain that the established procedure will be followed exactly throughout the job. (3) Frequent inspections to make sure that operations are being performed correctly and that materials meet specifications. (4) Occasional confirming tests of actual joints.

## Preliminary Inspection

Before any actual welding is done, the inspector should make sure that the welding procedure is one that has been properly qualified, and that its use will produce welds of the proper mechanical, physical and metallurgical characteristics. He must satisfy himself that the welders have, by actual tests, demonstrated their ability to make sound welds when following the prescribed procedures. He should check the joint design to see that it conforms to the qualified welding procedure. He must assure himself that the materials used are suitable for the purpose and conform to the requirements of any contract, code or specification governing the work.

## Visual Inspection of Work in Progress

An important duty of an inspector is the inspection of individual joints prior to actual welding to make certain that each joint has been properly prepared and fitted. The alignment of parts, fit of the backing ring, if used, and spacing of the pipe ends are especially important. No welder can produce a thoroughly sound joint where the parts to be welded have been poorly fitted.

He must make sufficiently frequent observations to determine whether the prescribed procedure is being properly followed by each welder, particularly as to welding current, number of passes being deposited and cleaning between passes.

Completed welds should be inspected visually for general appearance, noting the amount of weld reinforcement and the presence or absence of undercutting. When the underside of a weld is accessible, it should be inspected to determine whether complete penetration has been obtained and whether there are excessive globules or icicles of metal.

The inspector should make certain that, where required by code or specifications, the welds are stamped with the welder's symbol and any other symbol stamp that may be required.

If preheating or stress relieving of the welded joints is required, the inspector must make sure that the proper temperatures are obtained and held for the required length of time.

Complete inspection includes assurance that the insides of all pipes, valves and fittings are clean and free from blisters, slag, weld spatter, loose mill scale, sand and dirt when erected.

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The chapter on industrial piping of the new third edition of the American Welding Society's Welding Handbook—from which this material has been taken by special permission—was prepared by a committee consisting of D. H. Corey, The Detroit Edison Co., chairman; A. N. Kugler, Air Reduction Sales Co.; J. D. Mattimore, Tube Turns, Inc.; J. Hall Taylor, Taylor Forge & Pipe Works; H. Weisberg, Public Service Electric and Gas Co.; and C. C. Zimmerman, Benjamin F. Shaw Co.

## Non-Destructive Tests of Welds

Various methods of non-destructive testing have been utilized to a limited extent in the inspection of welded joints in piping systems where the service conditions are severe. Their purpose is to disclose defects, such as incomplete fusion, porosity and cracking, which cannot ordinarily be detected by visual inspection.

*Radiographic Inspection*

Radiography, using X rays or the gamma rays from radium, is occasionally used for examining welds in important work. X ray inspection requires the use of expensive and comparatively bulky equipment, whereas gamma ray inspection involves the use of easily transported radium or radium-activated materials.

Radiographic inspection should be conducted only by one well versed in the art of making radiographs, as well as in the interpretation of the film. This interpretation requires not only a knowledge of welding and weld defects revealed by this method, but also the exercise of considerable judgment as to whether a questionable area is actually defective. Experience is required also, to assure that the testing will be carried out in such a manner as to protect the testing personnel and others against harmful radiations from the source of X rays or gamma rays employed. Properly applied, the method should reveal defects that amount to 2 percent or more of the wall thickness. A standard set of radiographs, useful in checking the permissible degree of porosity in piping, may be purchased from the American Society of Mechanical Engineers.

*Magnetic Particle Inspection*

Magnetic particle inspection can be used only on magnetic materials. In application, the part to be examined is first magnetized by an electric current. The surface in the area to be examined is then covered with finely divided iron particles, either by sprinkling dry particles or by applying to the surface a coating of light oil in which the particles are in suspension. A crack or defect in the part, either at or near the surface, causes a discontinuity in the magnetic flux lines. The iron particles collect at that point, outlining the defect. The surface condition is important, as the smoother the surface the greater the contrast that results.

For most satisfactory results, the method should be applied only by one who is thoroughly familiar with its characteristics.

*Fluorescent Penetrant Inspection*

For inspection of non-magnetic materials with discontinuities extending to the surface, a fluorescent penetrant may be used. The inspection procedure is as follows: Clean part to be inspected, apply penetrant by brush, air spray or immersion, allow penetrant to remain on object for 1 hr and then wash clean with a water spray, dust on developing powder and inspect the object or area with the use of "black light" in semi-darkness.

*Trepanning*

Another method of inspection which is essentially non-destructive, though it does require a certain amount of repair welding, con-

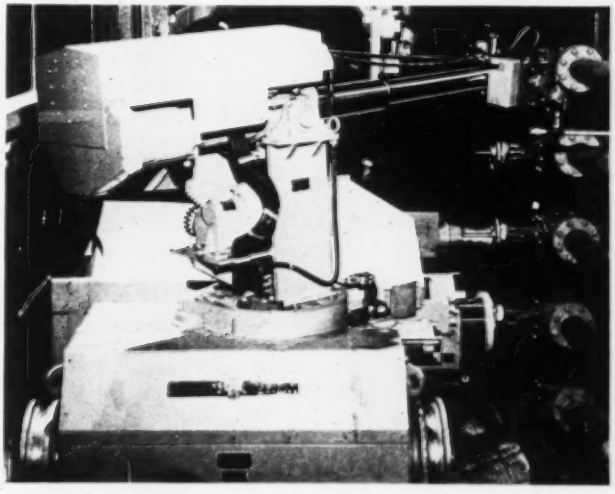
## *Robot on Wheels Operates Valves*

A FIVE TON, one-armed robot on wheels performs virtually any task expected of the human hand in the Atomic Energy Commission's production of plutonium at the Hanford works near Richland, Wash.

The robot, known as a "tool dolly," was developed by engineers of the General Electric Co., which operates the Hanford works for the AEC. Purpose of the apparatus is to perform tasks in radioactive areas unsafe for human beings. The dolly resembles a railroad handcar, with a small calibre deck gun mounted on it. The gun-like part of the dolly is a telescoping arm, with double clamps at the end. The arm can be extended, shortened, raised or lowered by remote control. The "hand" is capable of a wrist-bending motion, rotation and gripping.

Such operations as operating valves, taking apart and reassembling complex machinery, opening and closing doors, or picking up objects as small as dimes from the floor are all in a day's work for the dolly.

**One of the "tool dolly's" jobs is turning valves. The valve turning attachments are equipped with electric "feelers," which indicate whether the valve handle is properly centered in the grasp of the turner. The apparatus moves about its work area on the tracks**



sists of the removal of specimens from welds selected more or less at random, and by testing or otherwise examining these specimens. Such examinations serve to indicate the general character of the weld. Also, such inspection has a beneficial psychological effect on the welder, who has no idea from what points the samples will be removed.

The specimen may be a boat-shaped piece cut from the joint by means of a special power driven spherical saw; a cylindrical plug cut by means of a power driven hole saw; or a wedge-shaped piece obtained by making two intersecting saw cuts, one on each side of and close to the weld. Or a narrow strip may be obtained by making two saw cuts parallel to the run of the pipe and long enough to extend beyond the heat affected zone on both sides of the weld, and then removing the intervening plate by drilling or chipping the ends free.

After the specimen has been removed, it is ground or sanded, preferably on a surface that extends across the weld, and the prepared surface is then etched. Examination of the etched surface will disclose such defects as cracks, incomplete fusion or slag inclusions.

### Destructive Test of Selected Joints

The most thorough method for examining a joint is to remove a short section of pipe containing the weld. This involves the making of two joints in replacing the piece removed, but may be required in certain work. In the American Standards Association's Code for Pressure Piping, it is provided that, by agreement between the purchaser and the manufacturer or contractor, the quality of the work may be checked by removing a joint made by each welder. Such a joint may be given the standard destructive tests, such as the root, face, and side bend tests.

### Hydrostatic Tests

Hydrostatic testing of welded pipe lines is universally used. Extensive systems are often tested by this method in sections, the separation being made by valves, or, if there are flanged joints available, possibly with blind flanges.

As the expansive force of compressed air or other gas is relatively great, and since there is always a possibility of a failure under test, the use of air or other gas for testing is discouraged. It should be employed only under extraordinary circumstances and under competent supervision.

For most work, clean water is used. The temperature of the water should be no lower than that of the atmosphere. Otherwise, sweating will result and proper examination will be difficult. Bleeder valves or pet cocks should be provided at the highest point in the line to permit venting of all air in the piping during the filling operation.

The hydrostatic pressure should be applied gradually and should be left on for a sufficient length of time to permit making a complete examination of all welds. The pressure gage should be checked to be sure that it is functioning properly.

The test pressure should be that called for by the governing code, specification or contract. Lacking such instructions, it should be at least one and one-half times the maximum working pressure to which the piping will be subjected. For power piping the test pressure should never be less than 50 psi, nor more than two times the primary service pressure rating of any valves included in the test. Globe valves should not be subjected to a test pressure under the seat greater than one and one-half times the primary service rating. Full pressure, if it is more than one and one-half times, may be applied above the seat or with the valve open.

It may be necessary to protect expansion joints during testing, particularly when testing of the sections of the system is done prior to the completion of the entire system. Expansion joints of the slip type should be secured against possible separation. Other types should be studied to determine whether they need extra protection or support during testing.

Any evidence of leaking or other weakness under test should be marked. Following release of the pressure, defective areas should be repaired and another hydrostatic test made.

Further information on inspection methods and tests will be found in chapter 42 of the American Welding Society's Welding Handbook.

### Service Tests of Piping

The methods of testing described in the foregoing are designed to assure the quality of the welding before the system is put into service. In addition to such testing and inspection, many engineers place particular reliance on a service test, essentially a trial operation of a system under service conditions.

While the procedure for service testing varies with the installation there are certain precautionary measures, practically always applicable, that should be taken. These include the removal of all temporary test blanks and test connections, where necessary, the checking of all safety devices to make sure that they are in working order, the checking and setting of all valves and regulating devices for proper operation, and the checking of all hangers and anchor structures to make sure that they are functioning properly.

The results required, insofar as the welding of the system is concerned, are a demonstration that the welds are free from leaks and are capable of withstanding the stresses imposed on them by the service to which they are subjected. The fact that it is usually the contractor's responsibility to repair any leaks that develop during a service test, and to assume the liability for any damage to other work or equipment resulting from such leaks, is an incentive for him to make certain, as the work progresses, that the welds are so made as to be satisfactory for the service.

## MINNESOTA TO DEDICATE THREE NEW BUILDINGS

THE UNIVERSITY of Minnesota's institute of technology will celebrate the university's 1950-51 centennial with a three-day program in October which will be highlighted by the dedication of the new aeronautical, mechanical and chemical engineering buildings.

*Heating, Piping & Air Conditioning*

THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

*JOURNAL* *SECTION*

# Comparative Study of Ventilating Jets from Various Types of Outlets

By Alfred Koestel[1], Philip Hermann[2]*, and G. L. Tuve[3]**, Cleveland, Ohio

This paper is the result of research sponsored by
THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS
in cooperation with *Case Institute of Technology*

**SUMMARY — Several methods have been proposed for determining the character of air-supply jets discharged from various types of outlets. This paper proposes that a single, simple method can be used in most cases. Data are presented to show the advantages and limitations of this method when it is used for a variety of shapes and sizes of free openings, grilles, registers and perforated panels. Energy and momentum analyses are used in an examination of the basic fluid dynamics of air streams from the several types of outlets. Original test data are correlated with that available from other sources, and practical applications are indicated.**

## Theory

THE GENERAL energy equation may be applied, in differential form, to any two sections of a discharge air stream. Difficulties are encountered in the integration across the stream, and in determining the constants to be used in a practical case. The discontinuities of a perforated panel, and the near impossibility of measuring the conversion of kinetic or mechanical energy into heat are further complications.

The degree of turbulence in the stream leaving an air outlet is affected by the pattern of perforations or the configuration of the grille-lattice. The manner in which the individual jets coalesce to form a homogeneous stream affects the loss of directional kinetic energy and the magnitude of the residual velocity in the direction of the axis of the stream. Since the total energy is so difficult to measure, the next best approach is to apply the laws of motion and of continuity, setting up an equation on the basis of conservation of momentum. The assumptions involved in setting up this equation are certainly violated by the actual stream conditions, especially those existing near the outlet and those near the end of the throw. In the intermediate zone, however, the dynamic or inertia forces prevail and there is ample experimental evidence that the momentum equation applies with reasonable accuracy[1].

Using Fig. 1 as a representation of the air flow from a grille or other practical outlet, the initial total momentum in all the individual outlet jets, $M_1V_1$, may be equated to the momentum at any stream cross-section where the dynamic forces prevail:

$$M_1V_1 = \frac{\rho}{g} Q_1 V_1 = \int_{Q_1}^{Q_2} \frac{\rho}{g} V dQ$$

$$\int_{A_1}^{A_2} \frac{\rho}{g} V^2 dA$$

*where*

$M = \frac{\rho}{g}$ mass flow rate through outlet,

$\rho$ = density, pounds per cubic foot,

$g$ = acceleration due to gravity.

Exponent numerals refer to References.

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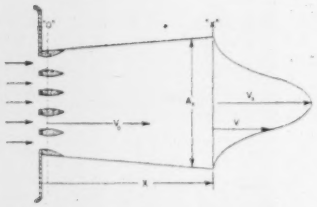


Fig. 1—Air jet from a typical grille or perforated panel

$dQ = V dA$.

$V_o$ = velocity at vena contracta.

$Q_o$ = volume flow rate through outlet.

$V$ = residual velocity at any point in the stream profile at a normal distance $X$ from the outlet.

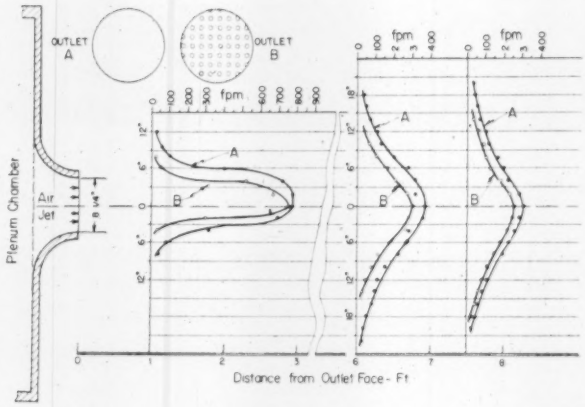
$A_x$ = stream cross-sectional area at distance $x$.

For isothermal conditions, the density term $\frac{\rho}{g}$ will drop out and the equation becomes:

$$Q_o V_o = \int_0^{A_x} V^2 dA \quad \ldots\ldots\ldots (1)$$

The original momentum, $Q_o V_o$, can be evaluated from measurements made at or near the supply outlet, and the momentum at section $X$ can be evaluated from the velocity profile at that section. (A velocity profile extending to zero in both directions is very difficult to obtain, see Figs. 2 and 3.) Wide use of Equation 1 is improbable because of the great amount of time required for accurate evaluation of velocity profiles in the various planes.

In a previous paper in this series[3] a substitute form of the momentum equation was derived using the more easily measured *maximum residual velocity* or centerline velocity of the jet. The same equation has been used by Rydberg and Norback[4] and others. Here again several assumptions are made, but experiment has shown that the equation gives a reasonably accurate measure of actual conditions in the stream from almost any type of opening, including perforated plates of low free area. In final form, the equation was expressed in terms of dimensionless parameters:




Actual perforations, outlet B, approximately 0.10 in. diameter, on $\frac{1}{4}$ in. centers

Fig. 2—Comparison of velocity profiles from two different outlets of same gross area (horizontal section)

$$\frac{V_x}{V_o \sqrt{C_d R_{fs}}} = K \frac{\sqrt{A_c}}{X} \quad \ldots\ldots\ldots (2)$$

This equation may also be written to give the throw in terms of cubic feet per minute and free area as follows:

$$X = \frac{KQ}{V_x \sqrt{A_f C_d}} = \frac{KV_f \sqrt{A_f}}{V_x \sqrt{C_d}} \quad \ldots\ldots\ldots (3)$$

*where*

$A_c$ = gross core area of outlet, grille face or perforated panel.

$A_f$ = free open area of outlet = $A_c \times R_{fs}$.

$C_d$ = coefficient of discharge for outlet.

$R_{fs}$ = ratio of free area to gross core area (decimal).

$K$ = the constant of proportionality or *throw constant*.

$Q$ = volume rate of flow through outlet.

$V_f = Q / A_f$ = average velocity through free-open area.

$V_o$ = velocity at vena contracta of jet from outlet or perforation (computed from $V = \sqrt{2gh}$).

$V_x$ = maximum residual velocity at centerline distance $X$ from outlet face.

Consistent units must be used in Equation 2; usually the most convenient are cfm, fpm and sq ft. For plotting on logarithmic coordinates with $\frac{V_x}{V \sqrt{C_d R_{fs}}}$ on ordinates, and

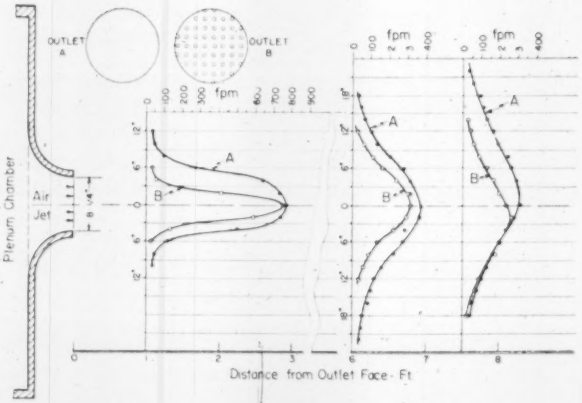



Fig. 3—Same test as Fig. 2 (vertical section)

**Table 1—Summary of Test Data and Results**

| Item No. | Type of Outlet | Per Cent Free Area | See Fig. No. | No. of Test Pts. | Outlet Velocity Range fpm | Coefficient of Discharge $C_d$ | Instrument Used for $V_x$ | Apparent Value of $K$ Eqs. 2 and 3 |
|---|---|---|---|---|---|---|---|---|
| **Tests at Case Institute of Technology, 1948-9** | | | | | | | | |
| 1 | Rounded nozzle, 8¼ in. diam | 100 | 2,6 | 16 | 700-1700 | 0.98 | A, B | 7.0 |
| 2 | Rounded nozzle, 2½ in. diam | 100 | | 5 | 900 | 0.93 | A | 7.0 |
| 3 | Sharp-edged orifice, 4¼ in. diam | 100 | | 8 | 4400 | 0.73 | A | 7.0 |
| 4 | Perforated metal panel, 8¼ in. diam | 40.5 | 7,8 | 18 | 3800-4800 | 0.83 | A | 6.2 |
| 5 | Perforated metal panel, 8¼ in. diam | 9.13 | 2,6 | 7 | 2900 | 0.75 | A, B | 4.5 |
| 6 | Perforated metal panel, 12 × 12 in. sq. | 6.3 | | 8 | 700-3300 | 0.74 | B | 3.7 |
| 7 | Perforated metal panel, 24 in. diam | 3.14 | | 5 | 3700 | 0.79 | A | 2.7 |
| **Tests at Case Institute of Technology, 1943** | | | | | | | | |
| 8 | Rounded nozzle, 11⅞ in. diam | 100 | | 29 | 1400-3900 | 0.99 | C, E | 7.0 |
| 9 | Rounded nozzle, 8¼ in. diam | 100 | | 35 | 1300-7000 | 0.98 | C | 7.0 |
| 10 | Rounded nozzle, 6 in. diam | 100 | | 41 | 1300-7000 | 0.98 | C | 6.5 |
| 11 | Sharp-edged orifice, 11⅞ in. diam | 100 | | 28 | 1300-2000 | 0.60 | C, E | 6.7 |
| 12 | Sharp-edged orifice, 8¼ in. diam | 100 | | 37 | 1600-7100 | 0.60 | C | 6.5 |
| 13 | Sharp-edged orifice, 2.54 in. diam | 100 | | 16 | 2000-7000 | 0.60 | C | 5.8 |
| 14 | Square opening 10 × 10 in., rounded | 100 | | 26 | 100-1600 | 0.83 | C | 5.3 |
| 15 | Square opening 8 × 8 in., rounded | 100 | | 22 | 500-1600 | 0.88 | C | 5.4 |
| 16 | Bar grille, 12 × 6 in., straight flow | 84 | | 40 | 400-2000 | 0.66 | C | 6.0 |
| 17 | Bar grille, 20 × 4 in., straight flow | 74 | | 41 | 400-2500 | 0.78 | C | 5.0 |
| 18 | Bar grille, 20 × 6 in., straight flow | 72 | | 27 | 400-1600 | 0.78 | C | 4.8 |
| 19 | Bar grille, 12 × 6 in., 40° total spread | 84[b] | | 23 | 900-2500 | 0.67 | C | 3.5 |
| 20 | Bar grille, 20 × 6 in., 40° total spread | 72[b] | | 20 | 1000-1500 | 0.75 | C | 4.0 |
| 21 | Bar grille, 12 × 6 in., 40° total spread | 67[b] | | 22 | 500-2400 | 0.63 | C | 3.2 |
| 22 | Bar grille, 20 × 4 in., 40° total spread | 74[b] | 9 | 40 | 1200-2100 | 0.70 | C | 3.0 |
| 23 | Bar grille, 12 × 6 in., 60° total spread | 67[b] | | 31 | 700-2400 | 0.61 | C | 2.3 |
| 24 | Bar grille, 20 × 6 in., 60° total spread | 72[b] | | 11 | 1000-1900 | 0.74 | C | 2.2 |
| 25 | Bar grille, 12 × 6 in., 60° total spread | 84[b] | | 12 | 900-2500 | 0.62 | C | 2.6 |
| 26 | Bar grille, 20 × 4 in., 60° total spread | 74[b] | 10 | 63 | 1200-2300 | 0.70 | C | 2.4 |
| 27 | Bar grille, 20 × 6 in., 90° total spread | 72[b] | 11 | 33 | 1100-1900 | 0.72 | C | 1.8 |
| **Tests at Kansas State College** | | | | | | | | |
| 28 | Nozzle, 2 in. diam | 100 | 13 | 18 | 1600-2000 | 1.00 | F | 6.5 |
| 29 | Nozzle, 4 in. diam | 100 | 13 | 75 | 900-2000 | 1.00 | F | 6.5 |
| 30 | Nozzle, 5.75 in. diam | 100 | 13 | 12 | 1300 | 1.00 | F | 6.5 |
| **Tests at the Technical University of Denmark** | | | | | | | | |
| 31 | Short nozzle, 3.9 in. diam | 100 | | 60 | 900-4900 | 0.87 | F | 7.1 |
| 32 | Short nozzle, 2 in. diam | 100 | | 38 | 1800-5600 | 0.99 | F | 7.6 |
| 33 | Conical nozzle, 5 in. diam | 100 | | 21 | 5400 | 0.98 | F | 7.2 |
| 34 | Sharp-edged orifice, 1.9 in. diam | 100 | 14 | 38 | 2500-5400 | 0.64 | F | 7.8 |
| 35 | Sharp-edged rectangular orifice 2 × 4 in. | 100 | 14 | 47 | 3500-5100 | 0.66 | F | 8.1 |
| 36 | Open-end pipe, 11.8 in. diam | 100 | | 43 | 700-1500 | 0.94 | F | 7.2 |
| 37 | Open-end duct, 11.8 × 11.8 in. | 100 | | 21 | 900 | 0.89 | F | 6.8 |
| 38 | Double curved nozzle 7.86 in. diam | 100 | 14 | 45 | 800-2300 | 0.97 | F | 7.0 |
| **Tests at Chalmers Technical University, Sweden** | | | | | | | | |
| 39 | Perforated panel, 8.8 × 8.8 in. | 37.4 | 15 | 11 | | 0.72 | F | 3.7 |
| 40 | Perforated panel, 12.8 × 12.8 in. | 37.4 | 15 | 11 | | 0.72 | F | 3.7 |
| 41 | Perforated panel, 19 × 19 in. | 37.4 | 15 | 12 | | 0.72 | F | 3.7 |
| 42 | Perforated panel, 8.5 × 8.5 in. | 19.6 | 15 | 32 | 1700-2300 | 0.67 | F | 4.2 |
| 43 | Perforated panel, 8.5 × 8.5 in. | 4.9 | 15 | 17 | 5800 | 0.67 | F | 4.5 |

Key to instruments used for measuring free stream velocity $V_x$:
A: Hot-wire anemometer
B: Heated thermometer anemometer
C: Bridled vane anemometer
D: Heated thermocouple anemometer
E: Rotating vane anemometer
F: Pitot tube

[b] $A_f$ and $C_d$ for all diverging grilles based on free area of equivalent straight-flow grilles.

$\frac{X}{\sqrt{A_o}}$ on abscissas (both dimensionless), the equation may be written:

$$\log_e \frac{V_x}{V_o\sqrt{C_d R_{fA}}} = -\log_e \frac{X}{\sqrt{A_o}} + \log_e K \quad \ldots\ldots\ldots\ldots\ldots (4)$$

The log-log graph of Equation 4 should therefore be a straight line with a slope of —1 and intercept at $\frac{X}{\sqrt{A_o}} = 1$ numerically equal to $K$. Equation 3 is the same as the proposed Equation 1*a* in the 1944 paper of this series.[4]

The throw-constant $K$ will be a maximum for a free-open rounded-entrance nozzle, indicating minimum losses of kinetic energy due to turbulence, and minimum angle of divergence of the stream. Either increased energy losses or increased angles of spread of the stream will give lower values of $K$. Experiments, however, show that this simple throw equation (Equation 3) is applicable and useful for predicting the behavior of free air streams from practically all outlets of the grille or panel type now in common use, including slots with an aspect ratio of less than 50.

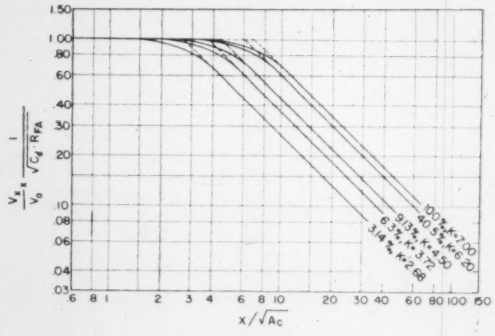
When it is required to determine the character of the stream very near the outlet, or at such a great distance from it that the viscous forces predominate, Equation 2 and the usual throw constants $K$ of Table 2 do not apply.

## Tests of Nozzles and Perforated Panels

To test the assumption that Equations 1, 2 and 3 may be applied to straightflow outlets of any type, irrespective of free area, a large number of experimental runs were made. In certain tests the overall size of the discharge outlet was held constant and the free area was varied. In other tests the gross area was varied. Runs were made over a wide range of air velocities and volumes. The results of some of the recent tests conducted are shown in Items 1 to 7 of Table 1.

To apply Equation 1, the stream velocity profiles must be determined, at various distances from the discharge face. Figs. 2 and 3 show the velocity profiles obtained by horizontal and vertical traverses at distances of 1 ft, 6 ft, and 7.5 ft from the outlet. Actual experimental integration is most difficult because of the time required and the problem of extending the velocity curves to zero at the fringes or periphery of the jet. Nevertheless, some valuable conclusions are possible.

For the results shown in Figs. 2 and 3, the test conditions were adjusted to produce approximately the same maximum velocity at 1 ft from the discharge face, using two outlets of the same gross core area but of different free area. A long-radius flow nozzle of 8¼ in. diameter was used, first with free-open discharge, then covered by a thin perforated plate of only 9.13 percent free area. The initial momentum, $Q_oV_o$, for the perforated panel discharging 72.5 cfm was about 10 percent higher than the initial momentum, $Q_oV_o$, for the free-open nozzle discharging 263 cfm, when in both cases the velocity at the center of the jet, 1 ft from the face, was about 750 fpm.




(Test points along smooth curves)

**Fig. 4—Approximate test curves for outlets of high and low percentages of free area. Velocities by thermal anemometers**

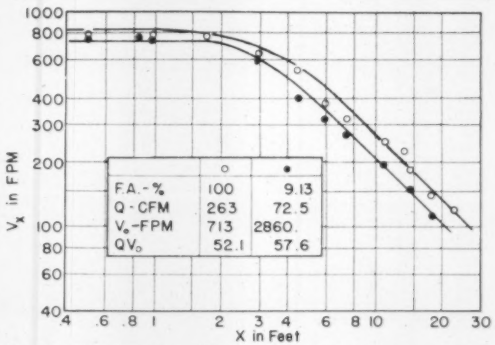



**Fig. 5—Maximum residual velocity in stream, plotting against distance**

(Data from same tests as Fig. 2)

The velocity profiles at 1 ft, 6 ft, and 7.5 ft from the face all indicate, however, a higher momentum for the *free-open* outlet. The ratio of the areas under the two curves appears to remain about the same, and this supports the assumption that the conservation of momentum applies in this zone of the free stream.

Applying Equation 2, if stream momentum could be equated between any two cross sections of the free and fully-formed jet (*i.e.* at 1 ft and 7.5 ft, Fig. 2), the value of $K$ for all streams, regardless of the type of outlet, would be the same. But when the momentum at one of these sections is equated to the original momentum at the outlet ($Q.V_o$), the turbulence imparted to the stream during the fusion of individual jets will result in a lower residual momentum at the distant cross-section. This will reduce the value of $K$ in Equations 2 and 3 for a perforated panel. Fig. 4 represents one set of test data for outlets with different percentages of free area. It appears that the momentum loss due to turbulence is small if the free area of the outlet is 50 percent or more. The larger momentum loss for a panel of low free area is accompanied by a change in the length of the transition zone near the outlet, as shown.

Fig. 5 is plotted from the same tests as Figs. 2 and 3, but utilizing the velocity readings at the center of the stream only, *i.e.*, the maximum residual velocity at each cross-section. In Fig. 6 the data of Fig. 5 are plotted non-dimensionally, and the values of $K$ are seen to be approximately 6.2 for the free-open nozzle and 4.5 for the perforated plate of 9.13 percent free area but the same gross area as the nozzle. (Read values at intersection $X/\sqrt{A}$ = 10 and multiply results by 10.)

Both the velocity profiles of Figs. 2 and 3 and the maximum residual velocities plotted in Figs. 5 and 6 support the conclusion that a major loss of momentum occurs in the mixing of the individual jets from a perforated panel.

Fig. 7 shows that if air is to be discharged at a given volume-rate, it is entirely possible to use a perforated panel and secure a blow or throw that *exceeds* that from a free opening. The rate of discharge of primary air from the perforated panel of Fig. 7 was about 5 percent less than that from the free-open nozzle of the same (gross) area, but the momentum $M.V.$ of the air from the perforated plate was about $2\frac{1}{2}$ times the momentum $M.V.$ of the air from the free-open nozzle, hence the longer throw of the former. A non-dimensional plot of the same data, Fig. 8 shows values of $K$, Equation 2, about 7.0 for the free nozzle and 6.2 for the 40 percent free-open panel of the same gross core area.

## Tests of Diverging Grilles

When the louvers (vanes or bars) of an air discharge grille are set to produce a wide horizontal spread of the stream, the throw or length of the free stream is reduced. The reason for this is apparent from the derivation of Equation 2 (see Reference 2). Figs. 9, 10 and 11 give evidence that Equation 2 may again be applied, with reduced values of the throw constant $K$. Other tests are reported in Table 1. A comparison of stream envelopes is shown in plan view in Fig. 12. These three stream outlines were all obtained with the same grille (12 × 6 in.) with adjustable bars set first for straight flow, then for 40 deg total angle and finally for 60 deg total angle. In all calculations with diverging grilles, the free area $A_f$ of the equivalent straight-flow grille has been used; hence $V_f$ in Equation 3 is a fictitious quantity, used only for convenience.

The value of $K$ to be used in any specific case is not easy to select, as shown from the several curves and from Table 1. There may be a long transition zone before the 45 deg portion of the curve is reached. The residual velocities are in general *less* than would be indicated by solution from the momentum law in the form of Equation 2, using a constant value of $K$; hence such computed results will always be on the safe side. This is also true near the end of the throw (due to viscous forces).

## Correlation and Comparison of Tests Results

The results of many earlier tests have been published in the previous

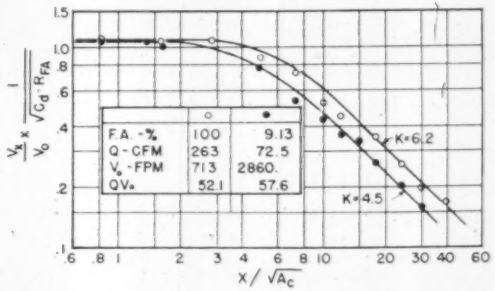


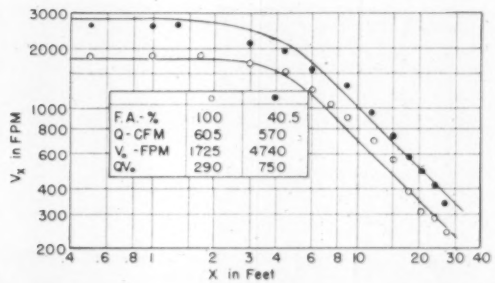

**Fig. 6—Data of Fig. 5 converted to dimensionless coordinates**

papers of this series.[1-4] Several other investigators have also published test results that confirm the assumption that Equation 2 is applicable to all outlets of the nozzle, grille or perforated panel type. A correlation of data from several sources is given in Table 1, and values of the throw constant $K$ are indicated. Items 1 to 27 represent tests made at *Case Institute of Technology*. Items 28 to 30 refer to Fig. 13 giving unpublished data on three round nozzles tested at *Kansas State College* under the ASHVE cooperative research project.[5] These latter tests, covering the downward projection of air at isothermal conditions, show a zone of nearly constant velocity to a distance of about $X / \sqrt{A} = 6$, then a sharp break and a 45 deg line with a value of $K$ somewhere between 6 and 7. The range of initial velocities $V_o$ was more than 2 to 1, and most of the points for residual velocity $V_x$ below 200 fall below the straight-line curves as previously explained (see open symbols at low end of curve).

A large number of test results were obtained and published by Becher[6] covering a variety of round and rectangular orifices and nozzles at discharge velocities from 800 to 5500 fpm, see Table 1, Items 31 to 38. A number of Becher's test runs have been replotted in Fig. 14, using the dimensionless parameters of Equation 2. Here again is the constant velocity zone and the rather sharp break with a 45 deg line at approximately $K = 7$.

Similar results were obtained by Tenelius[7] on perforated panels of 5 to 37 percent free area, as shown in Fig. 15. Here the values of the throw constant $K$ are in the low range, roughly from 3 to 5, but the effect of free area on $K$, and the 45 deg slope, are not fully verified. Data in Fig. 15 shown as solid black points are for tests on three different sizes of panel all of 37.4 percent free area and identical hole spacing.

Results obtained by Rydberg and Norback[8] would be similar, and they



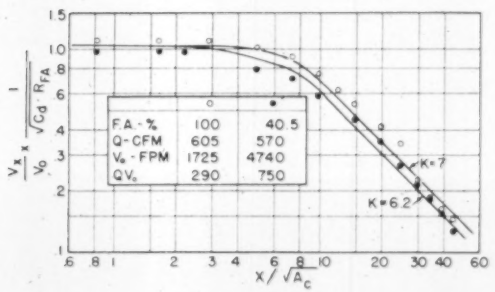




**Fig. 8—Data of Fig. 7 converted to dimensionless coordinates**

**Fig. 7 *(left)*—Maximum residual stream velocity for two outlets of the same gross area discharging approximately equal volumes**

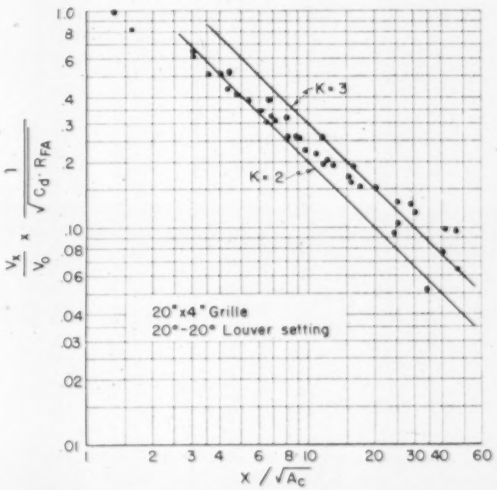



**Fig. 9—Tests on grille with diverging vanes set for 40 deg total angle of spread**

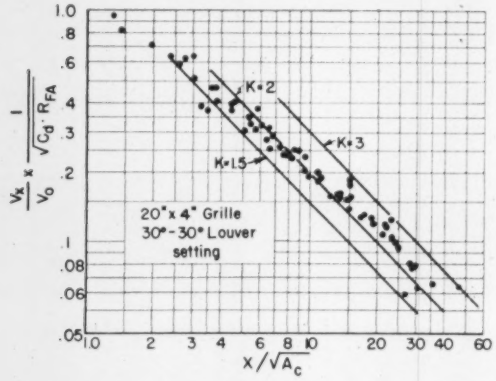



Fig. 10—Tests on grille with diverging vanes set for 60 deg total angle of spread

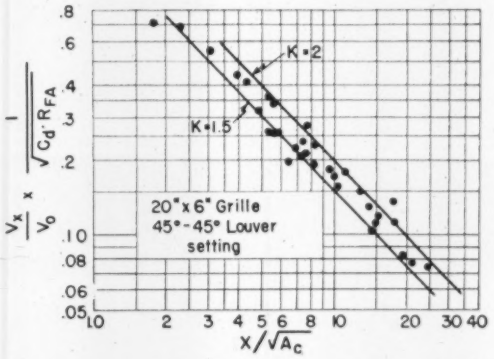



Fig. 11—Tests on grille with diverging vanes set for 90 deg total angle of spread

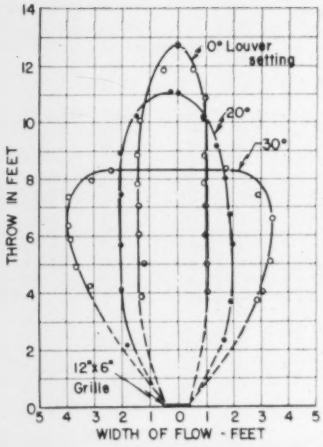



Fig. 12 *(left)*—Typical stream envelopes for the same grille with different settings of adjustable vanes. Points represent 100 fpm axial velocity

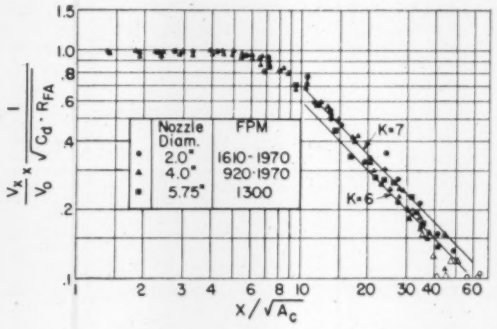



Fig. 13—Results obtained at Kansas State College for downward projection of unheated air streams from three rounded nozzles

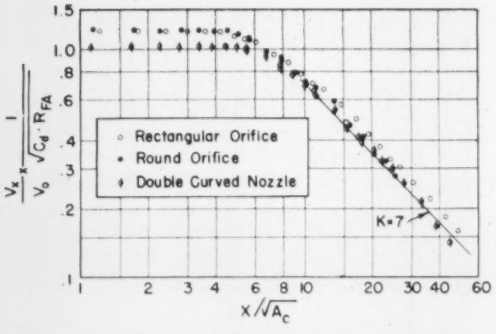



Fig. 14—Test results obtained at the Technical University of Denmark

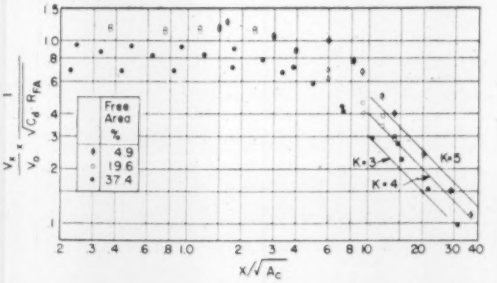



Fig. 15—Test results on perforated metal panels obtained at Chalmers Technical University, Gothenberg, Sweden

**Table 2—Suggested Values for the Throw Constant K, Equations 2 and 3**

| TYPE OF OUTLET | $V_x$ Measured with Thermal Anemometer $V_x$ above 200 |
|---|---|
| Rounded-entrance nozzles (Round, square or rectangular) | 7.0 |
| Square-edged openings (Aspect ratio 1 to 25) | 6.5 |
| Long slots (Aspect ratio 35 to 50) | 6.0 |
| Grilles and registers (Free opening 60 to 90%) | 5.5 |
| Perforated panels (Free opening 25 to 40%) | 5.0 |
| Perforated panels (Free opening 3 to 12%) | 4.0 |
| Diverging grilles Total angle 40 deg | 3.5 |
| Diverging grilles Total angle 60 deg | 2.5 |
| Diverging grilles Total angle 90 deg | 2.0 |

Notes:
1. For computations in the range $V_x$ = 75 to $V_x$ = 175, the values given in table may be 10 to 20 percent high.
2. When $V_x$ is measured with a mechanical vane anemometer, the values given in table may be 5 to 10 percent high.

suggested a value of the throw constant $K$ of about 5.6 for *grids of various constructions*.

## Practical Applications and Conclusions

The performance of the free air stream is obtainable by Equations 2 and 3, for round or rectangular orifices, nozzles, grilles, registers and perforated panels, also for slots having an aspect ratio less than 50, provided good entrance or approach conditions are maintained. The velocity *vs.* throw relationship involves two simple dimensionless ratios, a velocity ratio $\frac{V_x}{V_o\sqrt{C_t R_{Ex}}}$ and a ratio of linear dimensions $\frac{X}{\sqrt{A_o}}$. The selection of the constant of proportionality between these two ratios, *i.e.*, of the throw constant $K$, requires some judgment, and depends on the methods of measuring $V_o$ and $V_x$. Thermal anemometers of the hot-wire, heated thermocouple or heated thermometer type will give slightly higher readings of $V_x$ than mechanical directional anemometers (see discussion of experimental methods in Appendix).

A suggested table of throw constants $K$ for practical use, is given as Table 2. It is fully recognized that the use of Equations 2 and 3, with values of $K$ from Table 2 has decided limitations including those imposed by differences in temperature. In the range from 8 to 50 diameters from the outlet (*i.e.*, $\frac{X}{\sqrt{A_o}}$ from 8 to 50) a reasonably good accuracy is usually obtained until the final velocity at the center of the jet has been reduced below 100 fpm. (The *average* velocity across the jet will then be well below 50 fpm.) For straight-flow outlets and perforated panels, the *constant velocity zone* usually extends at least 3 diameters from the face, but for diverging grilles it is often only one diameter in length. No simple method seems to be available for predicting the maximum stream velocity in the zone nearer the outlet, say from 2 to 8 diameters from the face, except to assume that

$$\frac{V_x}{V_o\sqrt{C_t R_{Ex}}} = 1 \text{ (see Figs. 4, 6, 8, etc.).}$$

If Equations 2 and 3 and Table 2 are applied for this very near zone, or for the very far zone ($V_x$ below 100), the computed results will always be high, *i.e.*, on the safe side.

Many refinements in the computation of free-stream performance are still to be made, but Equation 2 and the estimated values of Table 2 are suggested as good approximations, pending additional work on the many questions that are as yet unanswered.


## Acknowledgments

The authors of this paper are greatly indebted to C. Y. Young and Miss Ruth Ehrenfeld, graduate research assistants at *Case Institute of Technology*, for their months of careful work in observation, calculation and plotting of test data presented in this paper.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2. ASHVE Research Report—Air Streams from Perforated Panels, by Alfred Koestel, Philip Hermann, and


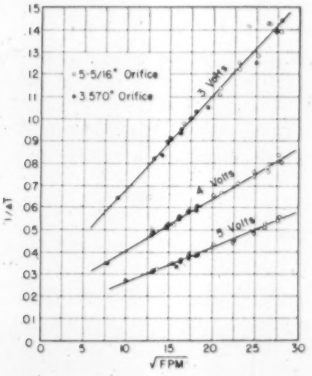


**Fig. 16—Calibration of heated thermometer No. 56 at various impressed voltages**
(ΔT temperature difference between heated and unheated thermometer)

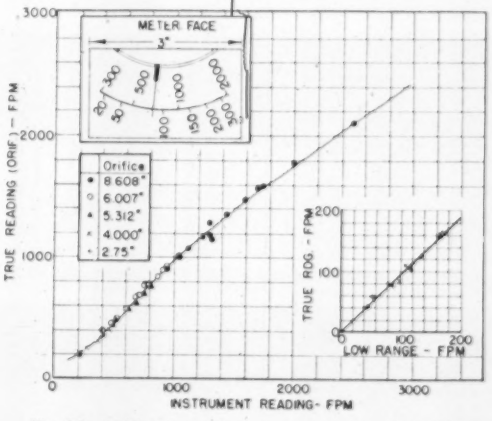


**Fig. 17—Calibration of hot-wire anemometer No. 781**

G. L. Tuve (ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, July 1949, p. 107).

3. Air Distribution and Draft, by John Rydberg and Per Norbäck (ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, January 1949, p. 167).

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5. ASHVE RESEARCH REPORT—Downward Projection of Heated Air, by Linn Helander and C. V. Jakowatz (ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, March 1948, p. 129).

6. Calculation of Jets and Inlets in Ventilation, (200 pages), Doctor's Thesis by Poul Becher (*The Technical University of Denmark*, Copenhagen, 1949).

7. Unpublished data obtained by private correspondence. See also Perforated Ceilings for Air Supply, by F. Tenelius (*Fläkten*, No. 2, 1947).

8. See Reference 3 and also Luftinblåsning och Drag vid Ventilationsanläggningar, by John Rydberg (*Tidskrift for Värme-Ventilations-Sanitetsteknik*, No. 11, November 1946, p. 143).

## APPENDIX

### Experimental Verification of Equations 1, 2 and 3

The experimental investigations conducted in the summer of 1949 at *Case Institute of Technology* were concerned with the verification of Equations 1, 2 and 3 under isothermal conditions. To check Equation 1, horizontal and vertical velocity profiles were taken, as shown by the example of Figs. 2 and 3. Equation 2 was tested by determining centerline velocities at various distances from the outlet discharge face, as in Figs. 5 and 6.

Most of the velocity determinations were made with a commercial type electric hot-wire anemometer. For purposes of comparison, a heated-thermometer was also used in evaluating centerline velocities for the data in Items 1 and 5, Table 1. Inasmuch as it took 15 min or so to obtain a reading with the heated thermometer, and because it agreed with the indication of the hot-wire anemometer within 2 to 3 percent, use of the heated thermometer was discontinued for the remainder of the runs. (Table 1, Items 2, 3, 4, and 7.) The calibration curves of the heated thermometer are shown in Fig. 16; they agree very closely with those in a previous investigation[7].

The hot-wire instrument consisted of a Wheatstone bridge with one of its resistances heated electrically. Variations of air velocity across this heated resistance change its value. Damping characteristics were quite pronounced and facilitated the taking of readings in the air stream. The calibration curves are given in Fig. 17.

The calibration procedure for the velocity measuring instruments was similar to that already described in previous papers in this series. Checks were obtained by using both flow nozzles and thin-plate orifices as the primary metering devices. Calibration results from the use of orifices and flow nozzles of various sizes usually checked within 1 percent of each other.

The various outlets and perforated panels were mounted interchangeably on a 48 in. cubical plenum chamber. The proportions and arrangement of the supply fan, duct and plenum corresponded to those specified in the Standard Test Code for Centrifugal and Axial Flow Fans*. Inclined manometers, calibrated against a hook gage, were used to obtain the pressure drop across a standard orifice in the duct, and to measure the static pressure in the plenum.

For better duplication of approach conditions the $8^1/_4$ in. nozzle was used for several runs. Variations in free area were attained by mounting the perforated panels on the discharge face of the nozzle. The other runs were made with the panels mounted directly in the wall of the plenum.

The velocity measuring instrument was mounted at the end of a long steel rod, and the instrument could be centered in any one of the squares of a 7-ft vertical grid. The grid was formed by 2 in. squares of fine thread; it was centered on the axis of the outlet stream at various distances from the discharge face.

The location of the experimental setup in the laboratory was such that it was free from drafts and obstructions. The distance from the outlet to the opposite wall was 30 ft; the nearest wall on the side was 15 ft from the stream centerline; the overhead was about 15 ft above the centerline, and the center of the outlet was 5 ft from the floor.

*Bulletin No. 103 *National Association of Fan Manufacturers*.

## "PHYSIOLOGY OF HEAT REGULATION AND THE SCIENCE OF CLOTHING"

This book, which was edited by L. H. Newburgh, M.D., Professor of Clinical Investigation, The Medical School, University of Michigan, was prepared at the request of the Division of Medical Sciences, National Research Council.

There are two main divisions of the book, Human Response to the Climatic Environment, and Clothing, a Thermal Barrier.

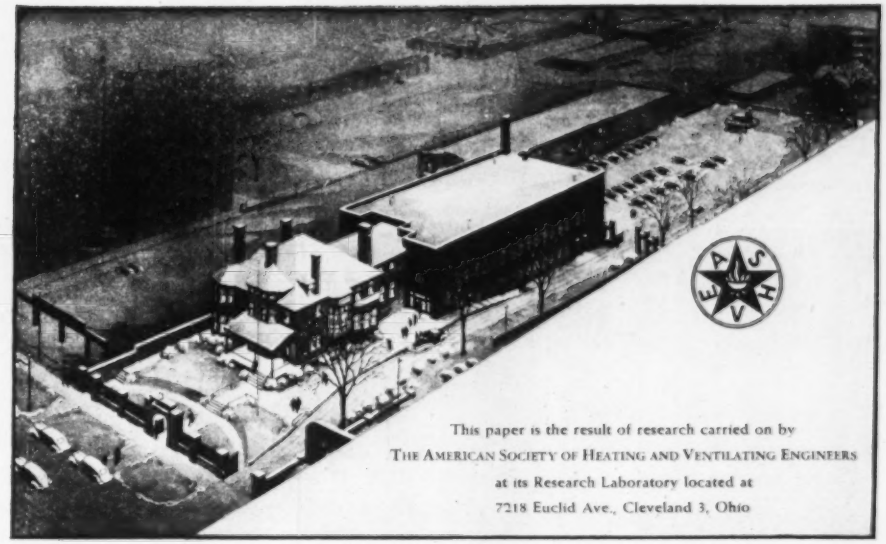
The book was prepared by a committee consisting of men who are familiar with one or more phases of the general problem of human reaction to environment and the effect of clothing. While the investigation was aimed chiefly at the problem of providing suitable clothing for various climatic conditions which might be encountered by Military Forces, the book constitutes a valuable reference on the human response to environment and the effect of clothing.

The subjects and authors of the various chapters are as follows:

Chapter 1. Adaptations to Climate Among Non-European Peoples by Frederick R. Wulsin; Chapter 2. Thermometry by C. P. Yaglou; Chapter 3. Heat Transfer by J. D. Hardy; Chapter 4. The Regulation of Body Temperatures by H. C. Bazett; Chapter 5. Physiological Adjustments to Heat by Sid Robinson; Chapter 6. Physiologic Adjustments to Cold by C. R. Spealman; Chapter 7. Regional Heat Loss by Richard Day; Chapter 8. The Range of Physiological Response to Climatic Heat and Cold by L. P. Herrington; Chapter 9. Indices of Comfort by C. P. Yaglou; Chapter 10. Physical Properties of Clothing Fabrics by Lyman Fourt and Milton Harris; Chapter 11. Laboratory and Field Studies, General Principles by W. H. Forbes; Desert by E. F. Adolph; Tropics by Sid Robinson; Protection Against Dry Cold by H. S. Belding; Wet Cold by C. R. Spealman; Water by C. R. Spealman; Special Problem of Hands by Marvin A. van Dilla, Richard Day and Paul A. Siple; Chapter 12. Clothing and Climate by Paul A. Siple.

This book attempts to describe the responses of the heat regulatory mechanism to the whole range of climatic conditions encountered on the earth's surface. It emphasizes the maximal capacity of the mechanism to preserve life under the most adverse conditions and establishes the limits of this capacity. It shows how far the rigors of unfavorable environments can be mitigated by scientifically designed protective coverings. However, it does not assume to have given final answers. The studies are being continued by both military and civilian groups.

The book, which is 6 × 9 in. size and contains 450 pages, is published by W. B. Saunders Co., Philadelphia. The price is $7.50.



This paper is the result of research carried on by
THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS
at its Research Laboratory located at
7218 Euclid Ave., Cleveland 3, Ohio

# A Proposed Psychrometric Chart

By H. B. Nottage*, Cleveland, Ohio

**SUMMARY—A new psychrometric chart has been prepared employing enthalpy and humidity ratio as coordinates in the style initially devised by Mollier. Principles of use are discussed in solving mass and energy balances.**

THE PSYCHROMETRIC chart is a fundamental tool of the air conditioning engineer. Acting upon the recommendation of the Guide Committee, the ASHVE Committee on Research has sponsored a critical appraisal of psychrometric calculation principles and practices which has culminated in the preparation of a chart being presented to the Society in this paper. Technical guidance in this development has been given by the Subcommittee on Thermodynamics[1] of the Guide Committee.

In preparing the chart the subcommittee established the following requirements: (1) best available thermodynamic data should be used, (2) chart form and content to be consistent with indisputable thermodynamic principles, and (3) chart to be styled for convenient use.

Any psychrometric chart which is to be of real value must have distinctive features which aid in problem analysis. This is particularly true of the proposed chart, and guiding thermodynamic principles are emphasized in the discussion. Detailed consideration of all aspects of calculating techniques and the analysis of specialized types of problems, however, are beyond the scope of the present paper.

## The Chart

Two versions of the chart have been suggested: (1) a large chart for precise calculations suitable for inclusion in THE GUIDE, and (2) a smaller version about twice the size of Fig. 1, for more convenient use.

Also suggested are the use of more than one color and the addition of an auxiliary transparent protractor giving an alternative form of the ratio or slope scale.

The chart is plotted on oblique coordinates of enthalpy and humidity ratio. This method of plotting was originated by Mollier[2, 3, 4] in 1923. Goodman[4] has followed this arrangement.

The chart is based upon the thermodynamic data of Goff and Gratch as given in THE GUIDE,[5] 1950; these data include effects of the interaction between air and water vapor. Quantities appearing on the chart are defined in THE GUIDE[5] except for the two defined explicitly on the chart itself, namely, relative humidity and percent saturation.

Fig. 2 compares relative humidity and percent saturation according to the identical relationship

$$R = \frac{s}{[1 - (1 - s)\, f_s P_s / P]} \quad \ldots (1)$$

*where*

$R$ = relative humidity, expressed as a decimal.

$s$ = percent saturation, expressed as a decimal.

$P$ = observed (or barometric) pressure of the moist air.

$P_s$ = saturation pressure of pure water at the prevailing tem-

[1]Exponent numerals refer to References.

*Research Associate, ASHVE Research Laboratory. Member of ASHVE.

[1]T. F. Rockwell, *chairman*; H. D. Lifton, and H. B. Nottage.

Presented at the Semi-Annual Meeting of THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, Muskoka, Ontario, Canada, June, 1950.

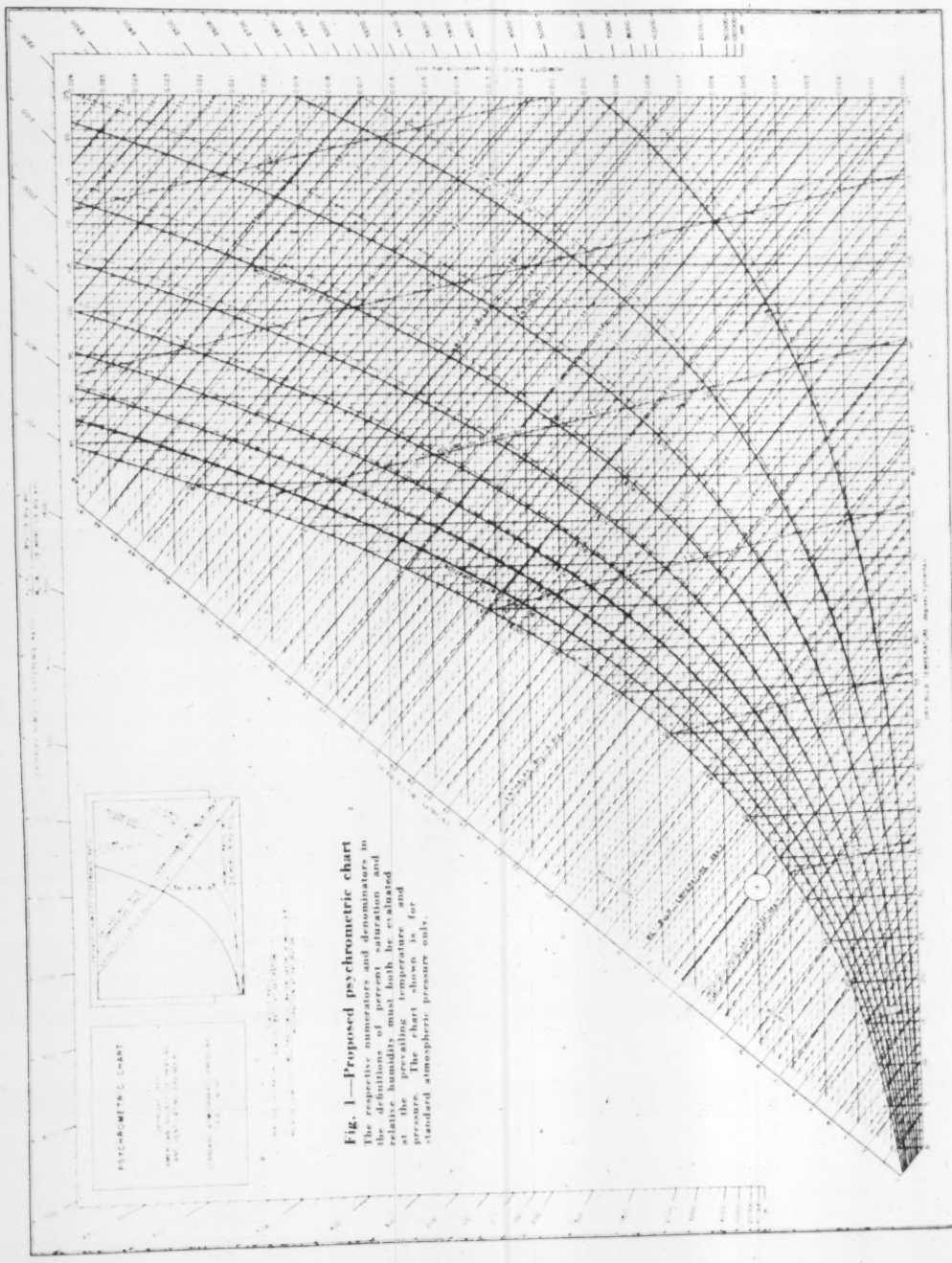


**Fig. 1—Proposed psychrometric chart**
The respective numerators and denominators in the definitions of percent saturation and relative humidity must both be evaluated at the prevailing temperature and pressure. The chart shown is for standard atmospheric pressure only.

## Nomenclature

$f_a$ = factor in Equation 1 and Table 1, dimensionless.

$G$ = rate of flow of dry air, pounds per hour.

$H$ = enthalpy of an *entire* non-flow system expressed as Btu per (pound of air in the system).

$h$ = enthalpy of moist air, Btu per (pound of dry air).

$h_w$ = enthalpy of water, Btu per (pound of water).
$h_{w_l}$ refers to liquid, $h_{w_v}$ to vapor, and $h_{w_s}$ to solid water, respectively.

$L$ = rate of flow of liquid water, pounds per hour.

$M_a$ = total mass of (dry) air within a non-flow system, pounds.

$M_w$ = total mass of water within a non-flow system, pounds.
$M_{w_l}$ refers to liquid, $M_{w_v}$ to vapor, and $M_{w_s}$ to solid water, respectively.

$P$ = observed pressure of moist air, psi or other units.

$P_s$ = saturation pressure of pure water, psi or other units.

$_1Q_2$ = heat added to non-flow system between states 1 and 2, Btu.

$_1\dot{Q}_2$ = rate of heat addition to a flow system between states 1 and 2, Btu per hour.

$R$ = relative humidity, defined on Fig. 1, dimensionless.

$S$ = rate of flow of solid water, pounds per hour.

$s$ = percent saturation, defined on Fig. 1, dimensionless.

$t_{wb}$ = thermodynamic wet bulb temperature, Fahrenheit degrees.

$V$ = rate of flow of water vapor (pure, no air) pounds per hour.

$w$ = humidity ratio of moist air, (pounds of vapor)/(pound of dry air).

$t$ = dry bulb temperature, expressed in the same units as $P$.

$f_a$ = a dimensionless factor which may be regarded as accounting for influences arising when air and water are intermixed.

Magnitudes of $f_a$ have been reported by Goff and Gratch[4] and by Goff[5]. Table 1 gives $f_a$ for the conditions of the ASHVE chart. The saturation pressure $P_s$ is well established.[5, 6]

### Principles of Psychrometric Mass and Energy Balances

The foremost use of the psychrometric chart is in locating state points of moist air and in diagramming and calculating mass and energy balances for air conditioning equipment and systems. The principles of these balances are fundamental to load estimates, specifications, equipment selection, and performance analyses.

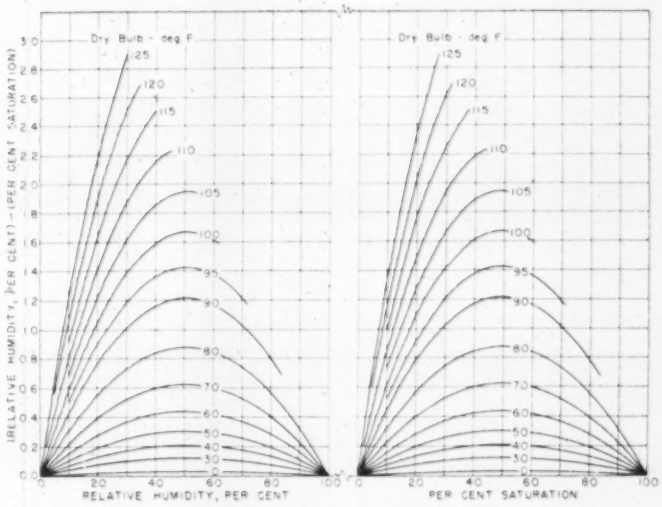



**Fig. 2—Comparison of relative humidity and percent saturation within the range of the chart**

It is also possible to develop uses of the chart in treating point-to-point variations in the state of moist air within a process, as governed by the particular rates of heat and mass transfer existing between the overall limits of a change, but this latter topic is not considered in this paper.

Psychrometric mass and energy balances are restricted to include only the substances air and water (liquid, solid, or vapor), either as pure substances or as mixtures. The two most frequent kinds of balances are: (1) non-flow under constant pressure and (2) steady flow. Only these two cases will be treated in this paper. Furthermore, steady-flow systems treated here will be limited explicitly to those in which changes of kinetic and potential energies are negligible compared to enthalpy changes.

Within this limited category all balances may be most simply stated in terms of enthalpies, humidity ratios, heat and/or work quantities or rates, and mass flow rates or total masses. This observation is fundamental to the choice of enthalpy and humidity ratio as chart coordinates. Non-flow and steady-flow balances are summarized in following paragraphs.

1. *Non-flow balances at constant pressure*

a. Mass balance

$$M_w + M_a = C \quad \ldots\ldots (2)$$

$$\frac{M_w}{M_a} = \frac{C}{M_a} - 1 \quad \ldots\ldots (2_a)$$

*where*

$M_w$ = mass of water (liquid, solid, vapor) in the system, pounds.

$M_a$ = mass of air (dry) in the system, pounds.

$C$ = a constant.

If only the gaseous phase is involved, Equation 2a specifies a constant humidity ratio.

b. Energy balance ($M_a \neq 0$)

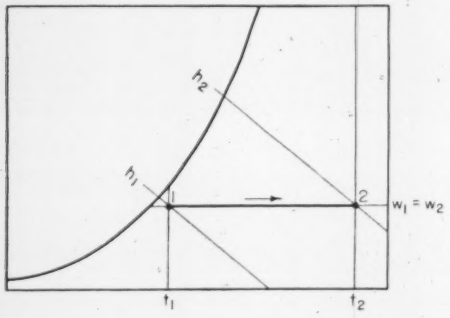
$$\frac{{}_1Q_2}{M_a} = H_2 - H_1 \quad \ldots\ldots (3)$$

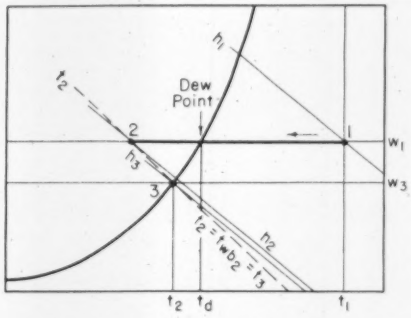
*where*

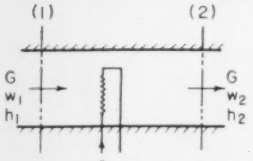
$_1Q_2$ = heat added to the system between states 1 and 2, Btu.

$H$ = enthalpy of the *entire* system expressed as Btu per (pound of air in the system).

In the majority of air conditioning problems it is satisfactory to neglect the solubility of air in liquid and solid water. The enthalpy then is expressed



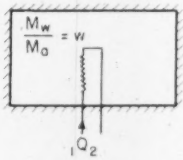




Steady flow

$_1q_2 = G(h_2 - h_1)$

$w_1 = w_2$

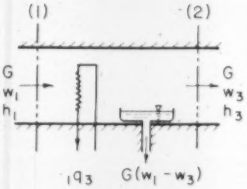



Nonflow

$_1Q_2 = M_a(h_2 - h_1)$

$w$ = constant

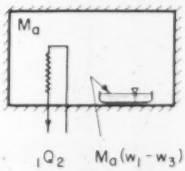
**Fig. 3—Heating of moist air at constant pressure**




Steady flow

$_1q_3 = G\left[h_1 - h_3 - (w_1 - w_3)h_{w3}\right]$

$_1q_2 = G(h_1 - h_2) = {}_1q_3$




Nonflow

$_1Q_2 = M_a\left[h_1 - h_3 - (w_1 - w_3)h_{w3}\right]$

$= M_a(h_1 - h_2)$

**Fig. 4—Cooling of moist air at constant pressure with condensation of liquid water**

as Btu per pound of air in the gaseous phase, or, more conventionally, as Btu per pound of dry air. Also, with liquid and/or solid water present, a further convenience is to resolve the enthalpy of the entire system into constituent parts according to phase, i.e.,

$$H_1 - H_2 = \left(h_1 + \frac{M_{w1}}{M_a}h_{w1} + \frac{M_{s1}}{M_a}h_{s1}\right) - \left(h_2 + \frac{M_{w2}}{M_a}h_{w2} + \frac{M_{s2}}{M_a}h_{s2}\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

*where*

$h_1$ = enthalpy of *moist air*, Btu per (pound of dry air).

$h_{w1}$ = enthalpy of liquid water, Btu per pound.

$h_{s1}$ = enthalpy of solid water, Btu per pound.

$M_{w1}$ = mass of liquid water, pounds.

$M_{s1}$ = mass of solid water, pounds.

With air solubility neglected, $h_{w1}$ and $h_{s1}$ are taken for the pure substance.

If only the gaseous phase is involved, Equations 2 and 3 yield an enthalpy change at constant humidity ratio.

2. *Steady-flow balances*

Two possibilities in general may be noted: (1) total rate of mass inflow for all streams entering a system equal to total rate of mass outflow for all streams leaving, and (2) total mass inflow rate not equal to total mass outflow rate because of some substance being deposited or picked up within a system which may not be directly discernible by an observer outside of the system. The deposition or sublimation of ice on the surface of an enclosed coil is an example of the second possibility. Only the first case however will be given detailed discussion here.

The solubility of air in liquid or solid water is to be neglected for present purposes.

a. Mass balance.

$$\sum_{\text{inflow}} [G(1 + w) + L + V + S] = \sum_{\text{outflow}} [G(1 + w) + L + V + S] \quad \ldots\ldots (5)$$

*where*

$G$ = flow rate of *dry air*, pounds per hour.

$w$ = humidity ratio, (pounds water vapor) per (pound dry air).

$L$ = flow rate of liquid water, pounds per hour.

$V$ = flow rate of water vapor (pure, no air in stream), pounds per hour.

$S$ = flow rate of solid water, pounds per hour.

$\sum$ denotes summation over all inflow or outflow streams.

b. Energy balance.

$$\sum_{\text{inflow}} (Gh + Lh_w + Vh_w + Sh_s) + q_1 + W_1 = \sum_{\text{outflow}} (Gh + Lh_w + Vh_w + Sh_s) \quad \ldots\ldots (6)$$

*where*

$h_w$ = enthalpy of water vapor (pure, no air in stream), Btu per pound.

$q_1$ = rate of heat inflow, Btu per hour.

$W_1$ = rate of work input, Btu per hour.

While it is true that the relationships given introduce no properties beyond enthalpy and humidity ratio, practical utility of the chart as a universal tool calls for the inclusion of dry bulb and wet bulb temperatures, volumes, and indices of the condition of the air in relation to saturation. These properties are all needed in locating and describing states on the chart.

**Table 1—Magnitudes of $f_s$ for the Range of the Proposed Chart**

(Standard Barometric Pressure, 29.921 in. Hg)

| Temp. F | $f_s$ | Temp. F | $f_s$ |
|---|---|---|---|
| 0 | 1.0048 | 70 | 1.0045 |
| 10 | 1.0046 | 80 | 1.0047 |
| 20 | 1.0046 | 90 | 1.0048 |
| 30 | 1.0045 | 100 | 1.0050 |
| 40 | 1.0044 | 110 | 1.0053 |
| 50 | 1.0044 | 120 | 1.0055 |
| 60 | 1.0044 | 125 | 1.0057 |

*Note:* The original source[6] gives $f_s$ to seven significant figures over the temperature range −208 F to +202 F and over the pressure range 20 to 35 in. Hg.

## Elements of Psychrometric Mass and Energy Balance Calculations

Mass and energy balances deal only with net changes between definite states; the detailed history of a change is not involved. A chart used to facilitate such calculations must primarily aid in clearly establishing states. Lines drawn on the chart to connect different states need have no other significance than being loci lines, that is, lines which contain the two terminal points of a change according to particular overall conditions imposed. Loci lines are commonly called *condition lines* for the processes concerned. On the proposed chart a condition line is characterized by its slope, $(h_2 - h_1) \div (w_2 - w_1)$.

Use of the chart of Fig. 1 is limited to standard barometric pressure. Steady-flow changes commonly involve pressure drops with the flow, but so long as these pressure drops remain a small fraction of the barometric pressure no appreciable errors need arise from using a constant-pressure chart.

Simple examples are given in the following paragraphs 1 to 7 to illustrate the elements of psychrometric calculations in terms of enthalpies, humidity ratios, and mass flow rates or total masses. In all instances the solubility of air in liquid or solid water is neglected.

1. Fig. 3, heating of moist air at constant pressure.

2. Fig. 4, cooling of moist air at constant pressure with condensation of liquid water.

By definition the dew point corresponding to any state such as 1 is $t_s$ as shown.

The enthalpy $h_{w3}$ is that of liquid water at temperature $t_3 = t_s$ and under barometric pressure.

This example illustrates one use of the chart region to the left of the saturation line. It is important to recognize that $G\ (h_1 - h_3) \neq q_s$.

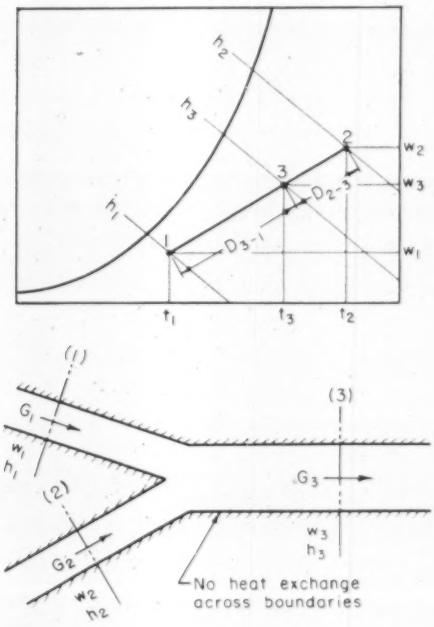
3. Fig. 5, adiabatic mixing of two steady-flow streams of moist air at constant pressure.

The distances $D_{2\text{-}3}$ and $D_{3\text{-}1}$ are scaled linearly from the chart.

A convenient form in which to remember the mixing rule is $G_1 D_{2\text{-}3} = G_2 D_{3\text{-}1}$.

4. Fig. 6, addition of moisture to an adiabatic system in steady flow at constant pressure.

The moisture may be added at any state (liquid, solid, vapor) but all of the moisture must be in the vapor state

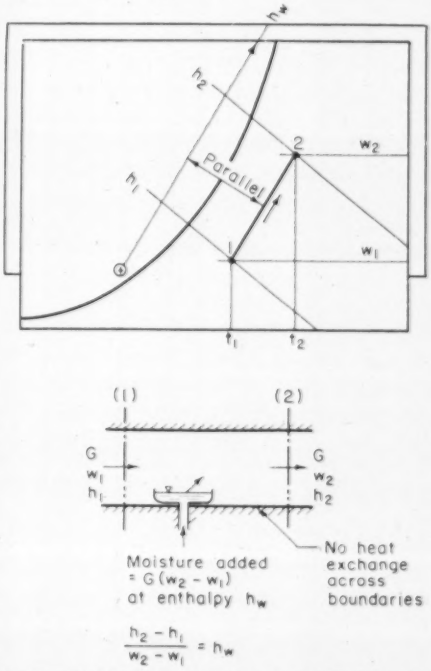



$$G_1 + G_2 = G_3 \qquad G_1 w_1 + G_2 w_2 = G_3 w_3$$

$$G_1 h_1 + G_2 h_2 = G_3 h_3$$

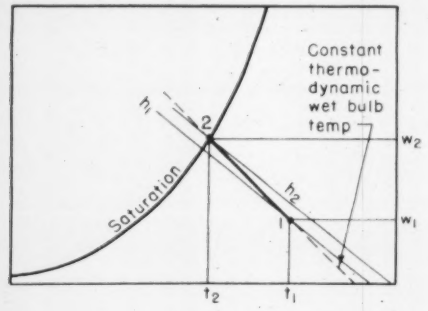
$$\frac{G_1}{G_2} = \frac{h_2 - h_3}{h_3 - h_1} = \frac{w_2 - w_3}{w_3 - w_1} = \frac{D_{2\text{-}3}}{D_{3\text{-}1}}$$

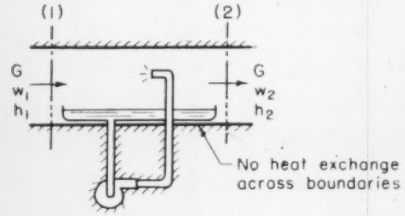
**Fig. 5—Adiabatic mixing of two steady-flow streams of moist air at constant pressure**




$$\frac{h_2 - h_1}{w_2 - w_1} = h_w$$

**Fig. 6—Addition of moisture to an adiabatic system in steady flow at constant pressure**

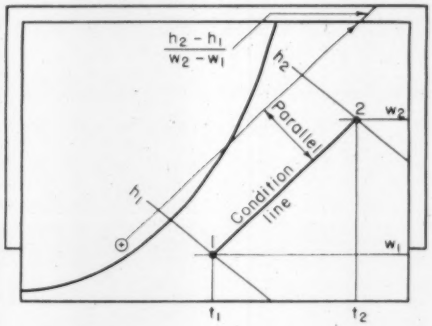



$h_2 \neq h_1$ $\qquad t_{wb_2} = t_{wb_1}$

Evaporation rate = $G(w_2 - w_1)$

**Fig. 7—Adiabatic saturation or adiabatic humidification at constant pressure with recirculated spray water and steady flow**



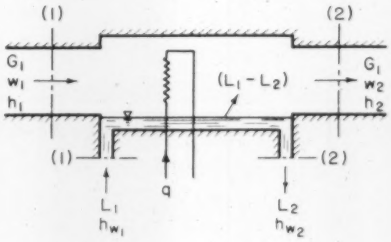




**Fig. 8—Exchange of heat and moisture between air and water streams in steady flow at constant pressure**

Energy balance, $\quad h_2 - h_1 = \dfrac{L_1 h_{w_1} - L_2 h_{w_2} + q}{G_1}$

Mass balance, $\quad w_2 - w_1 = \dfrac{L_1 - L_2}{G_1}$

Ratio $\quad \dfrac{h_2 - h_1}{w_2 - w_1} = \dfrac{L_1 h_{w_1} - L_2 h_{w_2} + q}{L_1 - L_2}$

at section 2 for the system visualized. For one example, a proper choice of $h_w$ will yield a substantially isothermal change of humidity ratio.

5. General adiabatic saturation at constant pressure.

Adiabatic saturation denotes any process wherein the state of moist air is changed from some initial condition to the saturation curve in an adiabatic manner. The moisture addition dealt with in Fig. 6 may become adiabatic saturation within this definition if the line 1-2 intersects the saturation curve.

6. Fig. 7, adiabatic saturation or adiabatic humidification at constant pressure with recirculated spray water and steady flow. In a saturation process the spray water ultimately will come to the same temperature as the saturated leaving air; this temperature is, by definition, the thermodynamic wet bulb temperature, $t_{wb}$. The adiabatic *saturation* process has its final state on the saturation curve at the wet bulb temperature of the entering air, while an adiabatic *humidification* process is one in which $t_{wb2} = t_{wb1}$ but for which the final state does not reach full saturation.

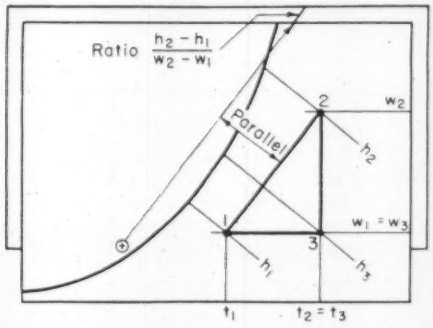
7. Fig. 8, exchange of heat and moisture between air and water streams in steady flow at constant pressure. Given state 1, the ratio $(h_2 - h_1)/(w_2 - w_1)$ establishes the slope of the *condition line* which must contain state 2. Setting $L_2 = 0$ yields the case of heat and moisture addition without through flow of water.

The heat and water additions may in any instance be treated as removals by changing algebraic signs.

## Discussion

In becoming familiar with energy-balance calculations the following sequence of steps in problem solving is suggested: (1) a schematic diagram of the system concerned, noting known and unknown quantities, (2) a sketch of the psychrometric chart upon which a skeleton layout and solution of the problem may be developed, (3) the writing of mass and energy balances, and (4) expression of condition-line slopes in terms of known or determinable quantities. Balances may be written for the system as a whole or for any part which may be schematically isolated, *e.g.*, a coil, a mixing section, a washer, a fan, a room, a dehumidifier, or a combination of appropriate elements.

Psychrometric literature often refers to the "sensible" and "latent" components of a moist-air enthalpy difference. Since the enthalpy difference between any two states is independent of the actual process path a difference such as $(h_2 - h_1)$ in Fig. 9 may be expressed as $(h_2 - h_3) + (h_3 - h_1)$, wherein point 3 is located by the constant humidity ratio line through 1 and the constant dry bulb line through 2. The quantity $(h_2 - h_3)$ may be called a "latent" difference and $(h_3 - h_1)$ a "sensible" difference if desired. If a triangle such as 1-2-3 maintained




Note: Angle 1-3-2 is exactly 90 degrees only for the 70 F dry bulb temperature line for the chart of Fig. 1.

**Fig. 9—Isothermal and constant-humidity-ratio components of an enthalpy change**

the same dimensions in all regions of the chart for a fixed length and slope of the side 1-2, then the sides 1-3 and 2-3 could serve to establish the remaining side in any location. This condition however is not true on the proposed chart, a triangle such as 1-2-3 is not, in general, a right triangle and hence slopes of lines such as 1-2 are expressed directly as $(h_2 - h_1)/(w_2 - w_1)$. An adjustment of practical usage is desirable to characterize a condition line in terms of the "total load," $(h_2 - h_1)$, and the "moisture load," $(w_2 - w_1)$.

The use of enthalpy and humidity ratio as coordinates gives a chart which can readily be extended to other temperature ranges and to other barometric pressures. The mass and energy balance calculations as formulated algebraically are not restricted as to temperature and pressure.

## Conclusions

1. The proposed chart, plotted on coordinates of enthalpy and humidity ratio and reproduced in two colors as recommended, offers thermodynamic consistency and convenient styling with no radical departure from other currently-used charts plotted on coordinates of humidity ratio and dry bulb temperature.

2. Mass and energy balance calculations employing enthalpy and humidity ratio are in accord with indisputable thermodynamic principles and are best organized with reference to a chart employing these properties as coordinates.

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2. Das i-x Diagramm für Dampfluftgemische, by R. Mollier (*Zeitschrift des Vereines Deutscher Ingenieure*, Vol. 73, p. 1009-1013, July 20, 1929).

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6. The Humidity Ratio of Moist Air at Saturation, by J. A. Goff and S. Gratch (Special Report of *University of Pennsylvania* Thermodynamics Research Laboratory, March, 1948).

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8. Psychrometric Factors in the Air Conditioning Estimate, by C. M. Ashley (ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, Vol 21, p. 107-114, March, 1949).

## APPENDIX

### Percent Saturation and Relative Humidity

The question of whether the proposed chart should contain percent saturation, relative humidity, or both, has been the most controversial single item considered by the Subcommittee. Presentation of both quantities on Fig. 1 of the paper is a compromise. The preferred styling would be to have only the most convenient and useful of the two quantities shown on the chart and then employ the curves of Fig. 2 as an interrelationship.

The explicit statements on Fig. 1 define the two quantities under considera-

| Consideration | Relative Humidity | Percent Saturation |
|---|---|---|
| 1. Definition | Mol fraction ratio is definite and applicable to real gas mixtures. Past definitions introducing perfect gas hypotheses have been inexact | Humidity-ratio ratio is definite and applicable to real gas mixtures. Can be applied to perfect gas idealization |
| 2. Units | Molal units not generally employed in air conditioning | Pound units are familiar |
| 3. Past Usage in Reporting Data | Large body of information expressed in relative humidity terms | Limited usage |
| 4. Comparative Magnitude | Both quantities same order of magnitude in range of Chart, see Fig. 2 | |
| 5. Aid in Tabular Calculations | Impractical; requires conversion to pound units for use of tables in pound units. Would find direct use, linear interpolation in chart range, if tables were in molal units | Direct use, linear interpolation in chart range, for tables in pound units. Impractical if tables were in molal units |
| 6. Use in Mass Transfer Rate | Usable with advantage that molal units are more fundamental for diffusion calculations and most directly applicable to thermodynamic equilibrium relationships | Usable for most rate calculations in range of chart. Convenient for introduction of Lewis relationship |
| 7. Application to Perfect Gas Hypothesis and Dalton's Rule | Simplest in definition of partial pressure. As an idealization $f_e$ in Equation A-1 may be taken as unity | Applicable through what amounts to a conversion to molal units |

tion. The definition of relative humidity has been chosen to avoid any sort of ambiguity arising through a Dalton's rule idealization. It is still possible to *define a partial pressure* as the product of mol fraction and total pressure; proceeding therefrom, the relative humidity definition may alternatively be written

$$R = \frac{x_w P}{x_{ws} P} = \frac{x_w P}{f_w P_s} \quad \text{.....(A-1)}$$

*where*

$x_w$ = mol fraction of water vapor in moist air at the prevailing pressure and temperature, dimensionless.

$x_{ws}$ = $x_w$ at saturation for the same pressure and temperature, dimensionless.

$P, P_s, f_w$ are defined in paper following Equation 1.

Judgment of convenience and utility between percent saturation and relative humidity requires thorough consideration. The accompanying tabulation summarizes many of the factors.

To summarize:

1. The weight of past usage, even though with inexact definition, favors relative humidity. This may be modified however by item 4 in the outline which would permit interchangeability for many practical cases.

2. So long as the air conditioning engineer deals in pound units, percent saturation has a strong advantage for calculation use.

3. If the air conditioning engineer were to convert to molal units, then the case for percent saturation would essentially collapse.

4. Neither quantity as defined has physical meaning beyond the range of states wherein the liquid and vapor phases may coexist in neutral equilibrium. If only the vapor phase is possible, the preference for molal or pound units, or a fractional or ratio composition would decide the issue and the recommended terminology would be either: (1) mol fraction, (mols) per (mol of mixture), (2) mol ratio, (mols) per (mol of other component), (3) mass fraction, (lb) per (lb of mixture), or (4) mixing ratio, (lb) per (lb of other component).

## SOCIETY'S TAX FREE STATUS RESTORED

The Society's application for reclassification of its tax exempt status, for income tax purposes, has been granted by the Commissioner of Internal Revenue. He has confirmed that the Society is classified as being exclusively for scientific and educational purposes. Contributions to the Society for research or for any of its other purposes are fully tax exempt. This also applies to bequests, legacies, or gifts of property to the Society.

## CHICAGO FAIR FEATURES HOME BUILDING

Prospective home owners and those already established as home owners who are looking for advanced ideas in home building will find the "home of their dreams" at the Chicago Fair of 1950, which opened June 24 on the lake front. The *Avenue of American Homes* exhibit, features a display of eight homes of contemporary or futuristic design.

Sponsored by materials' producers and home magazines, the homes fall into four architectural categories—Cape Cod, Colonial, Ranch and the so-called Modern style. Three are of frame construction, and one each of brick, concrete, plaster-steel, frame-stone and gypsum products. Two of the structures are of the expandable variety.

Each of the homes contains between 800 and 2000 sq ft of floor space. All are completely decorated and furnished from designs of prominent decorators. Supplying furnishings, appliances and heating units are leading manufacturers, wholesalers and retailers.

Crosby Kelly, executive manager of the Fair, stated that the role of the home in America's social and economic life had been assigned an appropriate location in the area along the lake front.

The official theme of Chicago's latest major exposition is the depiction and dramatization of this country's achievements of science, industry, commerce and agriculture which, under America's pioneer heritage, promise new, ever-higher standards in living.

In charge of the homes exhibit is Grover McDonald of Dixon, Ill., a home show developer for 30 years. He has been responsible for the construction of more than 150 such projects in various parts of the country. Assisting him is Joseph Shéehan of Philadelphia, Pa.

**Central Ohio Chapter celebrates Allen W. Williams Night. (Mr. Williams is second from right)**

# Thermal Conductivity of Soils for Design of Heat Pump Installations

By George S. Smith*, Seattle, Wash., and Thomas Yamauchi**, Detroit, Mich.

THE DESIGN of ground grids as a source of heat for the heat pump demands a considerable knowledge of the thermal properties of the soil, the most important of which is thermal conductivity. A search through the handbooks will reveal a rather limited amount of information, usually of little value since the specific conditions are seldom given. Thermal studies of the soil around underground oil lines and electrical wire ducts, or for foundation design are more informative, though the intent of such research often results in information not well adapted for use in design of pipe grids in soil.

At the present time, workers in various parts of the country are making thermal conductivity studies on soils, and for conditions in their location. While the data obtained by each worker may be somewhat influenced by the difficulties involved in the method of study chosen, or by the peculiarities of his soils, nevertheless, there is little doubt that the outcome of the combined efforts of all will result in some very definite and dependable information of considerable value in the heating field, as well as in other fields. This report presents the results of some rather extensive studies on a few of the usual types of soils, under rather widely varying conditions. It represents only a small portion of a somewhat extensive research program on ground grids and the various factors involved in the use of heat pumps.

*Professor of Electrical Engineering, University of Washington.
**Instructor in Electrical Engineering, University of Detroit.
Presented at the Semi-Annual Meeting of THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, Muskoka, Ontario, Canada, June, 1950.

**SUMMARY — Conductivities of typical soils were obtained by tests and are shown on charts for various density, moisture content and mean temperature conditions. Three test methods are described and comments are made regarding their use to obtain true values not affected by disturbance of the soil. One method was found to permit testing with least disturbance of soil. The importance of using soil conductivity values truly representative of the soil contents surrounding pipe grids is emphasized.**

## Problems Involved in Soil Thermal Conductivity Studies

The thermal conductivity of a soil varies greatly with its density and, to a lesser extent, with its moisture content. A change in the mean temperature of the soil causes only small changes in its conductivity, usually a small increase as the temperature increases. However, at temperatures well below freezing, the conductivity may again increase gradually, at least when some moisture is present. The nature of the soil is also a factor. The data presented seem to indicate that the inherent density, or maximum density to which the soil could be reduced by eliminating all voids, would determine its maximum intrinsic heat conductivity.

Most laboratory tests involve a disturbance of the natural state of the soil in the preparations for such work and therefore, questions arise as to the similarity between factors derived from laboratory tests and those for the undisturbed soil. In an attempt to eliminate the possibility of any serious error of this type, three very different methods were used on certain samples, one of which accomplishes the test with the least possible alteration of the soil from its natural state.

Another source of error arises from boundary films between the soil and test equipment. Careful tests indicate that the temperature distribution at the boundary surfaces often differs somewhat from that in the main soil body. This problem has been studied by means of special tests where thermocouples were placed at various distances near such surfaces.

## Apparatus and Test Procedure

*First Method*

The test equipment used in the first method described (the major portion of the data applies to this method) is similar to that used by Miles S. Kersten[1] at the University of Minnesota on tests conducted for the U.S. Army. Fig. 1 shows the general construction features. The main and guard heaters are made of brass tubing with internal nichrome heaters. They are thermally insulated from each other by plastic rings 5/16 in. thick. The two outer tubes form a tempering jacket which is cooled by an alcohol-and-water mixture held at the desired temperature by an electric water cooler. Each heating section is controlled separately, and the power input to the main heater is measured by a wattmeter. All temperatures are measured by calibrated copper-constantan thermocouples, using a potentiometer which can be read to a thousandth of a millivolt. The complete equipment used during the tests is shown in Fig. 2.

[1]Exponent numerals refer to Bibliography.

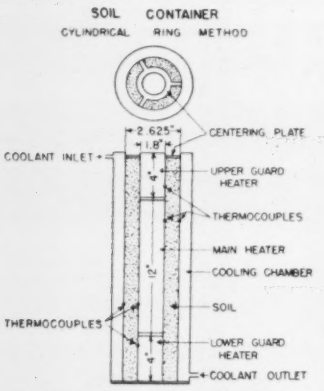


**Fig. 1—Soil container for the cylindrical ring tests (Miles S. Kersten Method)**

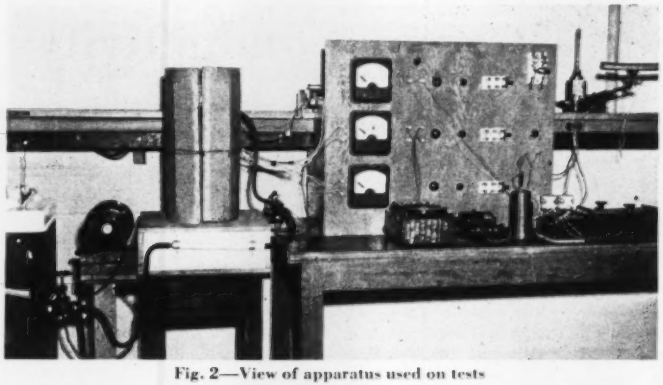

**Fig. 2—View of apparatus used on tests**

The procedure in making tests was as follows. With the volume of the test apparatus accurately known, a quantity of soil having the desired moisture content was carefully weighed out and divided into four parts. Then each fourth was packed sufficiently tight to fill one fourth of the soil space. The soil chamber was then sealed to prevent the loss of moisture.

The test was run by adjusting the three heaters and the cooler so that a difference in temperature of about 25 deg was maintained between hot and cold surfaces. The average of the hot and cold side temperatures was considered the average soil temperature. Also the temperatures of all heating sections were maintained equal within one degree or less. When these conditions were obtained and three readings taken at 10-min intervals gave results within 0.5 percent of each other, the test was considered complete. The duration of each test was three to four hours or longer.

The soil moisture was accurately measured as it was packed into the apparatus. Upon completion of the test and removal of the soil, a sample, taken from near the middle portion of the cylindrical ring, was again tested for moisture. If these two values did not check within one percent the test was discarded.

The following standard formula was used to determine conductivity:

$$k = \frac{q \log_e (r_2/r_1)}{2\pi l (t_1 - t_2)} \quad \ldots\ldots\ldots\ldots (1)$$

*where*

$k$ = Btu per (hour) (square foot) (Fahrenheit degree per foot).

$q$ = 3.414 × watts = Btu per hour.

$r_1$ = radius of heating tube, feet.

$r_2$ = radius of inside of cooling jacket, feet.

$t_1$ = temperature at $r_1$, Fahrenheit.

$t_2$ = temperature at $r_2$, Fahrenheit.

$l$ = length of main heater, feet.

Data obtained by this equipment will be termed *cylindrical ring tests*.

*Second Method*

In an attempt to compare results from laboratory tests to those in undisturbed soil, a few tests were made with a buried sphere. These will be termed *sphere tests*.

The equipment[2] for this work consisted of a spherical copper shell with heater and thermocouples as shown in Fig. 3. This sphere was placed at the bottom of a 5 ft deep hole drilled carefully and just large enough for the sphere to enter. All supply and thermocouple leads were brought to the surface through a $^3/_4$-in. plastic tube and the removed soil was carefully tamped back into place. Two other thermocouples were placed at horizontal distances of 20 and 27 in., respectively, from the sphere.

The heater was supplied with a known steady amount of power and all thermocouples were read at in-

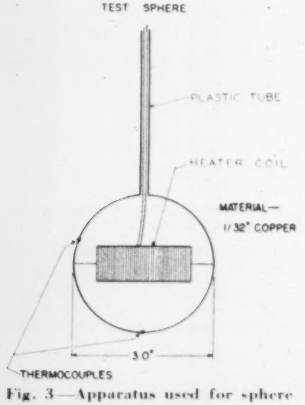


**Fig. 3—Apparatus used for sphere tests**

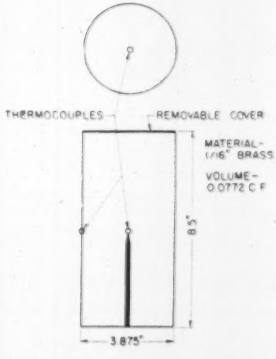


**Fig. 4—Cylindrical soil container for transient type of test**

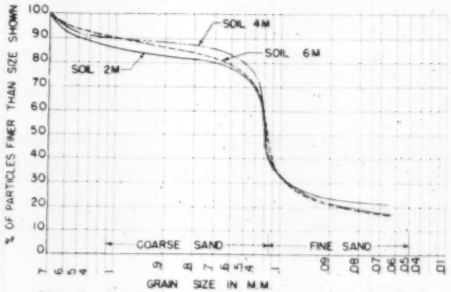


Fig. 5—Grain-size curves for sandy type soils

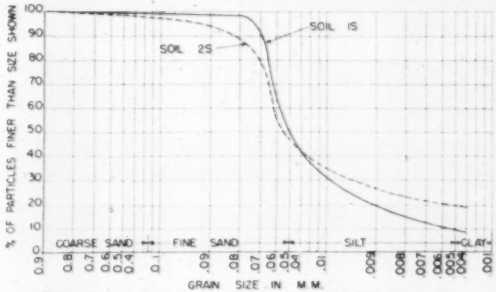


Fig. 6—Grain-size curves for clay and loam soils

tervals until steady state conditions were obtained. This operation usually required several days. The thermal conductivity was then computed by the following formula.

$$k = \frac{q\ (r_2 - r_1)}{4\pi\,(t_1 - t_2)\ (r_1 r_2)} \qquad (2)$$

All symbols are similar to those in Equation 1 except that $r$ is now the distance from the center of the sphere to the thermocouple considered and $t$ is the temperature measured by that couple.

*Third Method*

The third method employed is primarily a transient type of test to determine the thermal diffusivity of the soil, but the conductivity may be readily computed if the density and specific heat are also known. Details and theory of this method have been given Carslaw,[3] Newman,[3] and Shannon and Wells,[4] and will not be included here.

Fig. 4 shows the cylinder used for these tests. The container is packed full of soil at the density and moisture content desired, with one thermocouple on the surface of the cylinder and another fastened to a plastic support at the geometric center of the soil within. The cylinder, sealed water tight, is immersed in a water bath kept at the desired temperature until both thermocouples indicate a uniform temperature throughout. It is then immersed in an ice bath and the temperature-time curve of the center couple is obtained by reading the temperature about every six minutes until equilibrium is reached. By means of this transient curve the diffusivity, and finally the thermal conductivity may be obtained.

For test purposes the specific heat was determined by calculating the volumetric heat capacity for the component parts in the equation

$$C = p\left(c + \frac{w}{100}\right) \qquad (3)$$

*where*

$C$ = specific heat of sample, Btu per (cubic foot) (Fahrenheit degree).

$c$ = specific heat of dry soil, Btu per (pound) (Fahrenheit degree).

$p$ = dry density of the soil, pounds per cubic foot.

$w$ = water content as percent of dry weight.

The specific heat of quartz sand was taken as 0.20 and for clay as 0.175. Water was taken as 1.0. Since the specific heat values of various types of soil vary only a small amount, the derived value appeared adequate for the comparison of results.

*Soil Identification*

To describe the soil samples, two of the more or less standard methods were used. The first, described in detail in Report of Subgrade Soils,[5] identifies the soil by its liquid limit, plastic limit, and grain-size curve. The second is described by Casagrande[6] and identifies the sample according to the Casagrande table.

The liquid limit is obtained by forming a smooth layer of the soil and water mixture about three eighths of an inch thick in a suit-

**Table 1—Soil Chart**

| Sample No. | Description | Sample Depth ft | Undisturbed Density Lb per cu ft | Plastic Limit | Liquid Limit | Casagrande Notation | Specific Gravity | Maximum Density Lb per cu ft |
|---|---|---|---|---|---|---|---|---|
| 2-M | Sand, gravel, some clay | 2 | 90 | ... | ... | S W | 2.71 | 169 |
| 4-M | Sand, gravel, some clay | 4 | 90 | ... | ... | S W | 2.71 | 169 |
| 6-M | Sand, gravel, some clay | 6 | 90 | ... | ... | S W | 2.71 | 169 |
| 1-S | Clay | 1 | 29.4 | 40.6 | 61 | M H | 2.64 | 165 |
| 2-S | Clay and loam | 1 | 19.4 | 64.8 | 81.9 | O H | 2.39 | 149 |

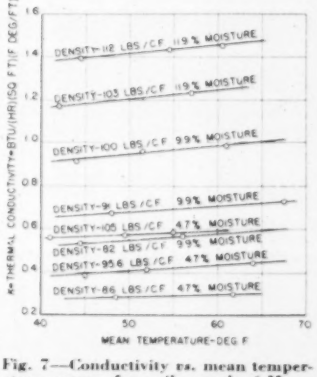


Fig. 7—Conductivity vs. mean temperature curves for soil sample 6-M, at various dry densities and percentage moisture contents

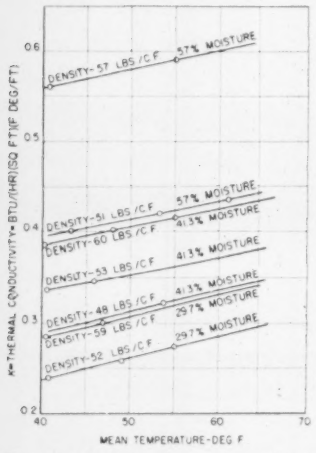
DENSITY-57 LBS/C F 57% MOISTURE
DENSITY-51 LBS/C F 57% MOISTURE
DENSITY-60 LBS/C F 41.3% MOISTURE
DENSITY-53 LBS/C F 41.3% MOISTURE
DENSITY-48 LBS/C F 41.3% MOISTURE
DENSITY-59 LBS/C F 29.7% MOISTURE
DENSITY-52 LBS/C F 29.7% MOISTURE
K=THERMAL CONDUCTIVITY=BTU/(HR)(SQ FT)(F DEG/FT)
MEAN TEMPERATURE-DEG F

**Fig. 8—Conductivity rs. mean temperature curves for soil 1-S at various dry densities and percentage moisture contents**

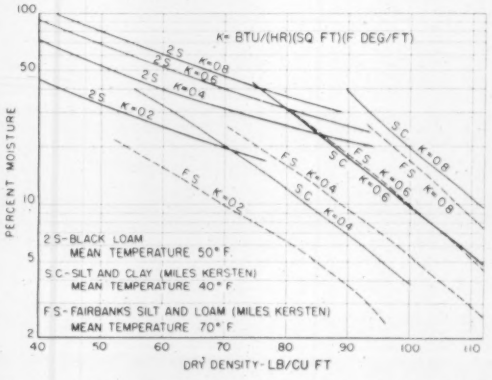
K= BTU/(HR)(SQ FT)(F DEG/FT)
2-S-BLACK LOAM
MEAN TEMPERATURE 50° F
S C-SILT AND CLAY (MILES KERSTEN)
MEAN TEMPERATURE 40° F
F S-FAIRBANKS SILT AND LOAM (MILES KERSTEN)
MEAN TEMPERATURE 70° F
PERCENT MOISTURE
DRY DENSITY-LB/CU FT

**Fig. 11—Percent moisture rs. dry density curves for soils 2-S and for silt-and clay and Fairbanks silt from Miles Kersten reports**

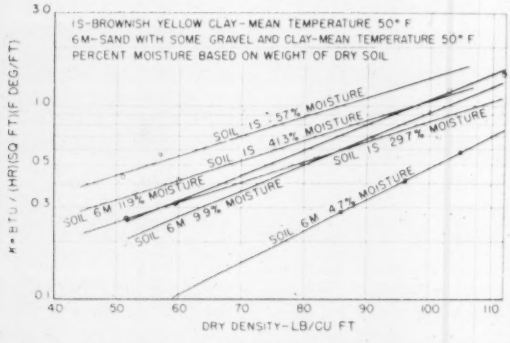
1S-BROWNISH YELLOW CLAY-MEAN TEMPERATURE 50° F
6M-SAND WITH SOME GRAVEL AND CLAY-MEAN TEMPERATURE 50° F
PERCENT MOISTURE BASED ON WEIGHT OF DRY SOIL
SOIL 1S 57% MOISTURE
SOIL 1S 41.3% MOISTURE
SOIL 1S 29.7% MOISTURE
SOIL 6M 11.9% MOISTURE
SOIL 6M 9.9% MOISTURE
SOIL 6M 4.7% MOISTURE
K=BTU/(HR)(SQ FT)(F DEG/FT)
DRY DENSITY-LB/CU FT

**Fig. 9—Conductivity rs. dry density curves for soils 6-M and 1-S at 50 F mean temperature and for moisture contents indicated**

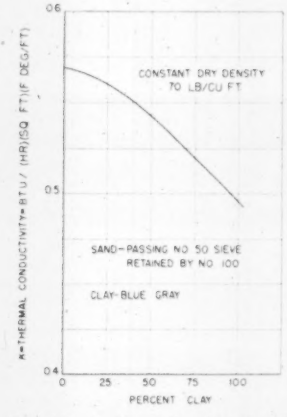


**Fig. 12—Conductivity of sand and clay mixtures**

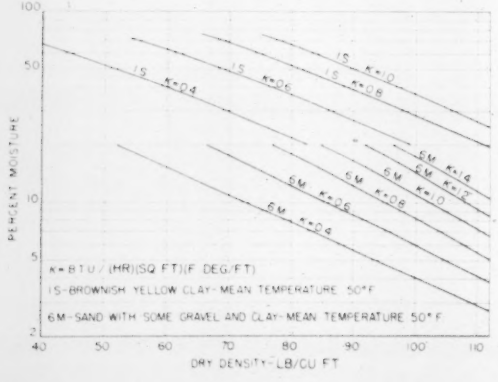
K=BTU/(HR)(SQ FT)(F DEG/FT)
1S-BROWNISH YELLOW CLAY-MEAN TEMPERATURE 50°F
6M-SAND WITH SOME GRAVEL AND CLAY-MEAN TEMPERATURE 50° F
PERCENT MOISTURE
DRY DENSITY-LB/CU FT

**Fig. 10—Percent moisture rs. dry density curves for soils 6-M and 1-S, at 50 F mean temperature and for thermal conductivities indicated**

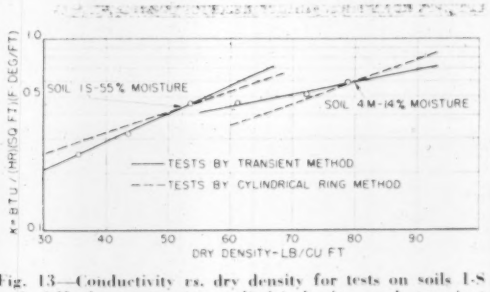


**Fig. 13—Conductivity rs. dry density for tests on soils 1-S and 4-M for comparing cylindrical ring and transient methods**

able dish. When this is grooved by a grooving tool and tapped lightly against the palm of the hand ten times, if the lower soil edges just meet, the moisture content is termed the liquid limit.

The plastic limit is the moisture content of the soil at which it can be rolled into threads one-eighth inch in diameter without the thread breaking.

The Casagrande System grades soils in fifteen groups indicated by letters as follows:

| Group | Compressibility and Expansion | Drainage Characteristics |
|---|---|---|
| GW | Almost none | Excellent |
| GC | Very slight | Practically impervious |
| GP | Almost none | Excellent |
| GF | Almost none to slight | Fair to practically impervious |
| SW | Almost none | Excellent |
| SC | Very slight | Practically impervious |
| SP | Almost none | Excellent |
| SF | Almost none to medium | Fair to practically impervious |
| ML | Slight to medium | Fair to poor |
| CL | Medium | Practically impervious |
| OL | Medium to high | Poor |
| MH | High | Fair to poor |
| CH | High | Practically impervious |
| OH | High | Practically impervious |
| Pt | Very high | Fair to poor |

The letter designations are described as follows:

G—Gravels and gravelly soils
S—Sands and sandy soils
W—Well-graded, fairly clean
C—(When used as second letter) Well graded, excellent, clay binder
P—Poorly-graded or uniformly graded, fairly clean
F—Coarse materials containing fines, not covered by other groups
M—Inorganic silty and very fine sandy soils
C—(When used as first letter) Inorganic soils
O—Organic silts and clays
L—Fine-grained soils having liquid limit 50
H—Fine-grained soils having liquid limit 50
Pt—Fibrous organic (peat and swamp) soils

The natural density of undisturbed soil of a sandy nature was obtained by digging a hole and obtaining the dry weight of the soil removed, then determining its volume by filling the hole with dry sand of known density. For wet clay or loam, a pipe, with the wall sharpened to a cutting edge on the outside periphery, was driven into the ground, and the depth of the hole and diameter of the pipe were carefully measured to determine volume.

All curves are plotted in terms of the dry density where the dry density is determined as follows:

$$\text{Dry density} = \text{Wet density} \;/\; (1 + \text{percent moisture})$$

The percent moisture is based upon the dry weight of the sample. This procedure will allow better comparisons between various types of soil.

## Results from Tests

*Cylindrical Ring Method*

Rather extensive tests were made on five samples of soil. Three of these were sandy in nature, a fourth was almost pure clay of a yellowish color, and a fifth, black loam containing some finely divided vegetable material. The soil chart (Table 1) gives the description and soil identification data on the five samples. Figs. 5 and 6 give the grain-size curves for the same samples.

Fig. 7 shows a series of curves for the 6-M sample which was quite sandy in nature. Here the thermal conductivity is plotted against mean temperature of the sample, each curve representing a definite density and moisture content. Fig. 8 presents similar curves for the clay type of soil. Actual test points are indicated. These curves indicate that the mean temperature of the soil has but little effect upon the thermal conductivity, though the density and moisture content are quite important. The relation of the conductivity to the mean temperature is quite linear over the temperature range used.

Replotting the data from curves as shown in Figs. 7 and 8, with conductivity on a log scale *vs.* dry density on a linear scale and all points selected at the same mean temperature, the results appear to be almost exactly linear. This same result was found to be true when plotting similar data reported by others. Assuming that the resulting curves should be straight lines, Fig. 9 presents such curves for samples 6-M and 1-S. All curves are for a mean temperature of 50 F and each curve is for a given constant moisture content.

Perhaps the most useful method of presenting this information was obtained by replotting with percent moisture content on a log scale, and dry density on a linear scale. Again the mean temperature was maintained at 50 F, while each curve was plotted for a constant value of thermal conductivity. In some cases the resulting curves were straight lines. Only a few diverged far from straight lines.

Fig. 10 shows such curves for samples 6-M and 1-S, and Fig. 11, those for the 2-S sample. The other two sets of curves on Fig. 11 are replotted from work reported by Miles Kersten.[1] The set marked F. S. is for Fairbanks silt loam with an approximate analysis as follows: sand of various sizes, 7.6 percent; silt, 80.9 percent and clay, 11.5 percent. This set of curves was taken at a mean temperature of 70 F. The set marked S.C. was described as silt and clay with, roughly, 30 percent sand, 15 percent clay, and the remainder silt. The mean temperature for these curves was 40 F.

The sandy type soils were all taken on the site chosen for experimental work with ground grids, and were so similar in thermal conductivity properties that only results from the sample 6-M taken at a six-foot depth are presented. The clay 1-S and black loam 2-S are definitely inferior heat conductors even at rather high moisture contents. This result was somewhat surprising since moisture would appear to be a very important factor, and clay types of soil will hold large percentages of moisture as compared to sandy soils. The superior heat conductivity of sand, together with the ability of clay to retain moisture, suggested tests on various mixtures of sand and clay to determine the possibility of some combination which might give a maximum conductivity.

For these tests, well graded sand was used of a size which passed

Table 2—Tests on Sand-Clay Mixtures

| Sand Percent | Clay Percent | Dry Density | Moisture Percent | $k$ Conductivity |
|---|---|---|---|---|
| 100 | 0 | 70 | 10 | 0.570 |
| 75 | 25 | 70 | 15 | 0.560 |
| 50 | 50 | 70 | 20 | 0.545 |
| 25 | 75 | 70 | 25 | 0.520 |
| 0 | 100 | 70 | 30 | 0.495 |

through a No. 50 sieve, but was retained on a No. 100 sieve. The clay was of the blue-gray variety. The test made with pure sand contained 10 percent moisture which is less than the sand would hold. Other tests were made with various percentages of sand and clay until the last was of pure clay. The dry density was held virtually constant on all tests, though the moisture content was allowed to increase in steps from 10 to 30 percent. Table 2 gives the results of the tests.

Conductivity plotted against percent of clay is shown in Fig. 12.

Soil thermal conductivity thus appears to be greatly influenced by the specific density of the soil, and while moisture content aids, it is of lesser importance.

*Effects of Surface Films and Moisture Migration*

All of the tests so far mentioned were made by means of the cylindrical ring method. The major portion was made by measuring only the temperatures at the hot and cold surfaces. To investigate the possibility of abnormal temperature changes due to surface film effects near the soil-metal junctions, a few tests were made by inserting extra thermocouples in the soil near both hot and cold surfaces. Thus, extra couples were held at $\frac{1}{8}$-and $\frac{1}{4}$-in. distances from each surface by means of a light plastic strip. The results of these tests indicated a rather small deviation near the surfaces from a linear temperature distribution for sandy type of soil, with a more pronounced deviation for clay, though not enough to make corrections desirable. Corrections indicated would result in thermal conductivities greater than for uncorrected values. Since the results of thermal conductivity tests cannot, in general, be duplicated with any great accuracy, and the lower values are on the safe side for design, the so-called uncorrected results have been given.

However, some interesting observations were indicated by these tests. The error was generally found to be greater on the heated side than on the cooled side. This difference is probably due to the tendency of the moisture to migrate from a heated, and toward a cooled surface. Thus, grids used for space cooling must be more liberally designed than those used for space heating. A further study of this film effect for various pipe diameters, soil conditions, etc., seems very desirable.

*Comparison of Laboratory Tests and Undisturbed Soil Tests*

A second test was made by the sphere method at a depth of about five feet below the surface and in the vicinity where the 6-M sample was obtained. This was necessarily at some little distance away. The undisturbed dry soil density was found to be about 90 lb per cu ft. At the time of the test the moisture content was 6 percent. The value of the thermal conductivity factor $k$ from this test was found to be 0.565.

For comparison, the value of $k$ for the same density and moisture from the curves determined by the cylindrical ring method was found to be 0.55. The comparison appears to be better than should be expected and later tests with the same sphere gave somewhat lower results but well within the possible percent of error. However, the results improve confidence in the cylindrical ring method as a means of thermal conductivity determination.

A second sphere was used to determine the conductivity of a very thick strata of hard pan soil which could not readily be tested by the cylindrical ring method. This strata was of a sand and clay type of soil containing almost no gravel and was only removable by means of a pick. The dry density was 138 lb per cu ft and moisture content at the time of the test was 8.3 percent. The thermal conductivity was 0.9 Btu per (hr) (sq ft) (F deg per ft).

*Comparison by Transient Method*

Several runs on samples 4-M and 1-S were carried out by the cylinder or transient method already described. The results as compared to those obtained by the cylindrical ring method are shown by curves in Fig. 13. Here again the results check reasonably well, though the theory and procedure differ greatly. This method proved to be the most convenient and speedy of the three methods used, and when only approximate results are necessary, would be quite adequate.

## Conclusions

The measurement of thermal conductivity is a rather difficult process and even with extreme care will often give quite varied results. Comparison with the data from other workers is difficult because of possible differences in the nature of the soil. More standardization in methods of procedure and means of comparison and reporting is most desirable.

The material reported in this paper was obtained entirely from experimental determinations and no attempt was made to derive general equations for mathematical determination. Miles Kersten[1] has demonstrated that, with sufficient experimental data, this can be done. Fig. 11, a composite chart, gives a comparison of results since the S.C. curve (silt-and-clay) was plotted from calculated data, while the 2-S and F-S were both from experimental results.

The thermal conductivity of any given soil is so greatly affected by the density that more attention should be given to the natural density of the undisturbed earth. Apparently the tendency is to pack soil in test apparatus to much

greater densities than are found naturally. When soil is disturbed in placing ground grids, the replaced soil is probably less dense than before removal, and may require years to reach the same natural density. In design, every attempt should be made to use thermal conductivities applicable to the actual conditions. These conductivities may be much lower than might be expected.

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3. Heating and Cooling Rectangular and Cylindrical Solids, by Albert B. Newman (*Industrial and Engineering Chemistry*, Vol. 28, No. 5, May 1936, pp. 545-49).

4. Tests for Thermal Diffusivity of Granular Materials, by W. L. Shannon and W. A. Wells (*American Society for Testing Material, Proceedings*, Vol. 47, 1947, pp. 1044-55).

5. Report of Subgrade Soils (Reprint from *Public Roads*, U. S. Department of Agriculture 12, No. 4578).

6. Classification and Identification of Soils, by Arthur Casagrande (*ASCE Proceedings*, Vol. 73, No. 6, Part II, June 1947, pp. 783-810).

## "ACOUSTIC MEASUREMENTS"

**By Leo L. Beranek**

This book is intended primarily as a reference for graduate students and workers in the field of acoustics. The author's object has been to cover the subject of acoustic measurements in such a way that the book will be an aid to five main groups of research workers: the acoustic physicist making fundamental laboratory measurements, the communications engineer measuring and evaluating the performance of audio communication systems, the psychologist performing measurements involving the human hearing mechanism, the otologist studying hearing defects, and, finally, the industrialist applying acoustic measuring techniques in manufacturing processes.

Dr. Beranek offers a clear and concise exposition of acoustic measuring techniques, and the entire subject of acoustic measurements. The book combines work published for the first time with information that previously was found only in isolated publications.

In addition to the treatment of acoustic measuring techniques, the author presents the source of the theory of many electro-acoustic phenomena, a description in detail of the basic types of acoustic measuring devices, such as microphones, sources, acoustic impedance bridges and analyzers, and a discussion of the relative advantages of alternate methods for accomplishing electro-acoustic measurements.

A short history of acoustic measurements is contained in the first chapter. An idea of the subjects treated will be obtained by review of the Table of Contents which follows:

Chapter 1. Introduction and Terminology; Chapter 2. The Medium; Chapter 3. Disturbance of Plane Sound Waves by Obstacles and by Finite Baffles; Chapter 4. Primary Techniques for the Measurement of Sound Pressure and Particle Velocity and for the Absolute Calibration of Microphones; Chapter 5. Microphones and Ears; Chapter 6. Measurement of Frequency; Chapter 7. Measurement of Acoustic Impedance; Chapter 8. The Audiometer; Chapter 9. Sound Sources for Test Purposes; Chapter 10. Characteristics of Random Noise; The Response of Rectifiers to Random Noise and Complex Waves; Chapter 11. Indicating and Integrating Instruments for the Measurement of Complex Waves; Chapter 12. Analysis of Sound Waves; Chapter 13. Basic Tests for Communication Systems. The Rating of Microphones, Amplifiers and Loudspeakers; Chapter 14. Tests for Laboratory and Studio Microphones; Chapter 15. Tests for Loudspeakers; Chapter 16. Testing of Communication System Components; Chapter 17. Articulation Test Methods; Chapter 18. Measurement of the Acoustic Properties of Rooms, Studios and Auditoriums; Chapter 19. Measurement of Acoustical Materials; Chapter 20. The Sound Level Meter.

The preparation of this book was made possible through funds supplied by the Office of Naval Research. The book is published by John Wiley & Sons, Inc., New York. The size is 6 × 8½ in., and the price is $7.00.

## NEW RESEARCH LABORATORY FOR AMERICAN-STANDARD

Heating research activities of the American Radiator and Standard Sanitary Corp. will be transferred from Yonkers, N. Y. to Louisville, Ky. A five-story building in Louisville is being remodeled and will be the new quarters for both the heating and plumbing laboratories of the company. The transfer of equipment and personnel will be made as soon as the remodeling is completed. John C. Reed is manager of the research department.

## JOHN R. ALLEN MEMORIAL LIBRARY

The ASHVE Committee on Research gratefully acknowledges the following gifts to the John R. Allen Memorial Library, which is maintained at the Society's Research Laboratory, 7218 Euclid Ave., Cleveland 3, Ohio.

*Handbook of the Fan Engineering Industry*, issued by the *Fan Manufacturers' Association Limited*, London, England. Gift of the Association.

The presentation of textbooks and pamphlets in the field of heating, ventilating, and air conditioning and allied fields, by authors and others, will be welcomed by this library. Suitable book plates carry the name of the donor and date of the gift.

# Summary of Chapter Meetings

## CHARTER PRESENTED TO INLAND EMPIRE CHAPTER AT SPOKANE

The 43rd Chapter of the Society, Inland Empire Chapter, with headquarters at Spokane, Wash., was presented with its Charter by E. O. Eastwood, past president of the Society, at a banquet held at the Spokane Hotel, May 5, 1950. Present for the inaugural meeting were representatives from the Pacific Northwest and Oregon Chapters.

William C. "Bill" Vradenburg, president-elect of the Society's newest Chapter and the spark behind its organization, received the Charter with Professor Eastwood's comment that it was not an "award or presentation for past accomplishments, but a charge with responsibility to uphold and strive to further the aims of the Society."

The official meeting was opened by chairman George Murray, who welcomed guests and called for self-introduction of the Spokane members. He then called on Merrill N. Musgrave, who introduced members of the Pacific Northwest Chapter, including, besides himself, C. A. Pangborn, S. D. Peterson, R. H. Liniger and E. H. Langdon. R. C. Chewning, president of the Oregon Chapter, introduced other Oregon members: Dick Blankenship, K. R. Murhard, R. W. Martig, K. H. Hanson, E. E. Kelly, and B. W. Farnes.

After introductions were completed, chairman Murray introduced J. Donald Kroeker, Portland, a member of the Society's Council, who formally introduced the principal speaker, Prof. E. O. Eastwood, professor of mechanical engineering at the University of Washington. Professor Eastwood, who was instrumental in the organization of the Pacific Northwest Chapter and became its first president, spoke on *The Great Challenge to Heating and Air Conditioning*. He referred to the history of the earth to illustrate that man at some point began to think of ways to be more comfortable until the present day he is the only earthly inhabitant that has learned to control his environment to the extent that he can live underground, under water, high above the surface of the earth, or at any place on the known surface of the earth. He also spoke briefly of the studies of our solar system as it may be related to the industry of heating and air conditioning and of the challenge to engineers to furnish comfort for all living persons, utilizing new forms of energy and new ideas yet to be developed.

In the business session following, permanent officers were elected as follows: *President*—W. C. Vradenburg; *Vice President*—L. E. Marque; *Secretary*—R. J. Harris; *Treasurer*—Harvey Jennings; *Board of Governors*—E. W. Bunnell, G. C. Murray, R. C. Schmidt.

Adjournment of the 43rd Chapter's first meeting was followed by congratulations by visiting persons and small groups remaining to talk over the many activities to come for this *youngster* Chapter.

## OKLAHOMA A & M STUDENT BRANCH RECEIVES CHARTER

The Oklahoma A & M Student Branch of the Society received its official Charter from John E. Haines, member of Council and of the Chapter Relations Committee, on April 27, 1950.

The Oklahoma Chapter members were guests at the dinner meeting at which the Charter was presented.

Guests were introduced by the Student Branch president, R. E. Metzkier. Col. P. S. Donnell, college vice president and administrative head, welcomed the group of 50 guests. Edward Stapley, dean of the Oklahoma Institute of Technology,

J. E. Haines presenting Charter to R. E. Metzkier, Student Branch President, Oklahoma A & M College

Mr. Haines receiving a "snow cone" during Charter presentation meeting at Oklahoma A & M College

commended Mr. Metzkier and his group for the splendid work accomplished since its recent organization.

H. S. Shafer, president of the Oklahoma Chapter, spoke about the aims and activities of the ASHVE and stated that it is the only professional organization that maintains its own Research Laboratory and conducts and coordinates fundamental and basic research in heating, ventilating, air conditioning, and cooling and the allied arts and sciences for public welfare and general benefit.

At the meeting, President Metzkier introduced the other student officers: *Vice President*—J. J. Murov; *Secretary*—W. D. Jenkins; and *Treasurer*—R. J. Gorenflo.

After the dinner meeting presentation, the guests were conducted on a tour of the engineering exposition.

• **BALTIMORE**—May 17, 1950. Following the dinner at the Engineer's Club, Pres. E. L. Crosby called the business meeting to order. A report of the Board of Directors meeting, which included a report of the auditing committee, was given to the general membership.

The election of officers for the 1950-51 season was held with the following results: *President*—G. B. Priester, *Vice President*—W. P. Flanigan, *Secretary*—N. L. Spinelli, *Treasurer*—E. S. Berngartt.

A very interesting talk was given by R. D. Tutt, chief engineer, Tuttle & Bailey, Inc., New Britain, Conn., and discussion covered sidewall, circular, and square ceiling outlets. The meeting adjourned at 10:00 p.m. Attendance 42. Attendance ratio 0.50.*

• **CENTRAL OHIO**—May 15, 1950. The meeting was called to order by Pres. E. A. Norman, Jr. at the Grandview Inn and the minutes of the April meeting were read and approved. The treasurer's account was audited by H. R. Allonier and A. T. English and then turned over to the new treasurer, N. T. Hess. The president's gavel was presented by E. A. Norman, Jr., retiring president, to R. S. Curl, who accepted it on behalf of H. G. Hays, the incoming president, who was not in attendance.

The speaker of the evening was R. A. Wilson, engineer, Minneapolis-Honeywell Regulator Co., Cleveland, member of the Chapter, who spoke on installation of baseboard radiation and showed slides to illustrate his talk. A. D. Bogen, secretary, presented a motion picture of the basketball game between Ohio State and Holy Cross. The meeting adjourned at 9:45 p.m. Attendance 27. Attendance ratio 0.22.

• **CENTRAL OHIO**—April 17, 1950. R. S. Curl, secretary and presiding officer of the meeting, called the meeting to order at the Grandview Inn at 6:30 p.m. The officers for the 1950-51 season were unanimously elected as follows: *President*—H. G. Hays; *Vice President*—R. S. Curl; *Secretary*—A. D. Bogen; *Treasurer*—N. T. Hess.

Brief sketches of present and past activities of the Chapter were made by three members, B. E. Petry, D. M. Long, and J. D. Slemmons. The guest speaker of the evening was W. R. Deimel, assistant to the vice president, Columbus and Southern Ohio Electric Co., who showed an extremely interesting film on the construction progress of an electric generating station being installed by the company. Attendance 22. Attendance ratio 0.18.

• **CONNECTICUT**—May 29, 1950. The members and guests met for dinner at Edrich's Restaurant, and Pres. D. M. Hummel presided and called the business meeting to order at 8:15 p.m. The minutes of the previous meeting were read and approved. President Hummel announced the appointment of the personnel to serve on the Chapter committees for the coming year.

There were two guest speakers for the evening, Robert Meyer and R. C. Molloy, both from the United Aircraft Corp., East Hartford, Conn. Mr. Meyer, supervisor of thermodynamics, spoke on the vortex tube and Mr. Molloy, executive research engineer, spoke on atmospheric duplication in the Aircraft Laboratory and jet developments. The meeting adjourned at 10:30 p.m. Attendance 41. Attendance ratio 0.23.

• **DELTA**—May 9, 1950. After dinner in the Trophy Room of the New Orleans Athletic Club, the business meeting was called to order by Pres. R. B. Guest. The members introduced themselves and their guests, after which the minutes of the April meeting were read and approved. Reports were made by the various committtee chairmen and President Guest expressed his appreciation for the fine work done by the various chapter committees and to the membership at large for the pleasure of having served them as their president for the 1949-50 season.

The election of officers for the 1950-51 season then took place with the following results: *President*—Ralph Elizardi; *Vice President*—Theodore Offner; *Secretary*—H. L. Salaun; *Treasurer*—Walter Cooke; *Board of Governors*—C. V. Bankston, F. D. Graham, R. B. Guest. Mr. Guest then turned the gavel over to the incoming President Elizardi who presided as the chairman of the meeting. President Elizardi presented a pen and pencil set to retiring President Guest as a token of appreciation from the chapter. He expressed his appreciation for the honor bestowed upon him and also expressed his desire to carry on the good work of the past presidents.

The membership then had the pleasure of viewing a very entertaining and informative film entitled *Louisiana*. Attendance 31. Attendance ratio 0.29.

*Note: The attendance ratios shown represent the membership attendance divided by the chapter membership. These ratios will be useful as a partial indication of interest shown by local chapter members in various types of subjects programmed by the various chapters and may be useful in deciding on subjects for chapter meetings.

# JOURNAL SECTION

• **GOLDEN GATE**—May 4, 1950. The roll call of members and introduction of guests followed the opening of the meeting by K. F. Baldwin, president and presiding officer, at the Engineer's Club in San Francisco. The minutes of the April 6 meeting were read and approved. E. L. Natkemper and Daniel Hayes reviewed the forthcoming 61st Annual Convention of *Heating, Piping & Air Conditioning Contractors National Association* and invited the members of the Golden Gate Chapter to attend.

Lawrence Jue gave an interesting and instructive talk on the design of ventilation in submarines. An interesting motion picture, *Silent Service*, showing U. S. submarines in action during World War II was shown. The meeting adjourned at 10:00 p.m. Attendance 78.

• **ILLINOIS**—May 8, 1950. The speaker at the May meeting of the Illinois Chapter was Lester T. Avery, president of the Society and president of Avery Engineering Co., Cleveland, Ohio, whose topic was *Dynamic Air Conditioning*. Mr. Avery pointed out that atmospheric contamination is one of the worst menaces to the working man, and he compared man's need for food and water with his requirements for air. He pointed out that while an individual can continue to work for relatively long periods of time without either food or water, he could not do so without air. He explained that air purification is a rather recent accomplishment and believes that the air conditioning industry has done a poor selling job considering what can be offered.

He further described results of tests outlining the limits of air temperatures and the effect of air on the human being, and with the use of slides explained the *zone of minimum strain*. Mr. Avery also showed slides describing various installations of air control equipment in factories and other buildings and concluded his talk by explaining how man is controlling his environment. According to the secretary's report, Mr. Avery's approach was unique and obviously very interesting to the membership.

At the end of Mr. Avery's discussion, the Chapter was entertained by a professional entertainer. Attendance 125.

• **IOWA**—May 9, 1950. Following dinner, the business meeting was called to order by Pres. D. E. Wells. The minutes of the previous meeting were read and approved as read. The report of the tellers of election showed that the following were elected for the year 1950-51: *President*—R. S. Stover; *Vice President*—C. P. North; *Secretary-Treasurer*—C. H. McGuiness. President Wells appointed Bowen Campbell and Robert Snell as the auditing committee to go over the treasurer's books.

The meeting was then turned over to R. S. Stover, the incoming president, who introduced H. E. Degler, technical director, The Marley Co., Kansas City, Kan., who gave a very interesting talk on the use of cooling towers and their relation to the conservation of water supply. Mr. Degler gave some interesting information on the increased use of water over the past 10 years as well as on falling water levels beneath the surface of the earth. He also pointed out examples of various types of cooling tower arrangements and what could be expected from each type. Following an interesting and informative question period, the meeting was adjourned at 10:00 p.m. Attendance 32. Attendance ratio 0.66.

• **MASSACHUSETTS**—May 16, 1950. A social hour and dinner held in the Campus Room of the M.I.T. Graduate House preceded the opening of the business meeting by Pres. W. H. Shipp. The annual reports of the secretary, W. A. Williams, and the treasurer, C. H. Dow, were presented. President Shipp introduced the new officers for the season.

D. W. Blair, the incoming president, introduced A. V. Hutchinson, executive secretary of the Society, New York, N. Y., and L. E. Seeley, first vice president of the Society and Dean, College of Technology, University of New Hampshire, Durham, N. H. Mr. Hutchinson spoke on the aims and purposes of the By-Laws of the Society, while Dean Seeley spoke briefly on membership. The meeting adjourned at 9:50 p.m. Attendance 23. Attendance ratio 0.22.

• **MEMPHIS**—April 17, 1950. The annual dinner meeting was held at the King Cotton Hotel with Pres. W. L. Wellford, Jr., presiding. Following dinner, the visitors were introduced and welcomed, after which the minutes of the previous meeting were read and approved. President Wellford then announced the annual election of officers and the tellers of election, N. C. Ledbetter, R. H. Schulz and E. E. Scott, reported the following results: *President*—C. S. Fischer; *Vice President*—R. E. Larkin; *Secretary*—A. T. Bevil; *Treasurer*—Everett Wynn.

Since the scheduled speaker, L. C. McClanahan of Aerofin Corp., was unable to be at the meeting, a sound movie *Explosion Danger Lurks*, featuring the dangers encountered with improperly protected water heaters and storage tanks, was shown through the courtesy of the Watts Regulator Co. Attendance 35.

• **MICHIGAN**—May 16, 1950. The annual meeting of the Michigan Chapter was held at the Meadowbrook Golf Club. The entire day was given over to golf, games, dinner and a business meeting which included the election and installation of new officers and Board of Governors for the forthcoming year. After the afternoon of golf, dinner was served at 7:00 p.m. and the meeting was called to order by Pres. L. A. Burch at 8:00 p.m. E. F. Glanz, chairman of the membership committee, reported on the year's activities and received the thanks of the officers for his efforts throughout the season. President

Burch then appointed L. A. Esslinger and G. H. Waid as auditors to audit the treasurer's books and report their findings at the first meeting of the coming season.

The following officers and board of governors were elected for the season: *President*—C. F. Donohoe; *Vice President*—G. W. Akers; *Secretary*—R. H. Oberschulte; *Treasurer*—C. A. Strand; *Board of Governors*—G. L. Davis, Jr., E. F. Glanz, J. H. Spitzley, L. A. Burch, *ex officio*. President Burch then instructed and installed each of the new officers and turned the gavel over to the incoming President Donohoe, who then presented the past president's plaque and a book of *Memories* to Mr. Burch. He accepted these mementoes from the chapter and expressed his sincere thanks for its consideration, as well as thanking the past officers of the chapter for the support they gave him during his tenure in office. The meeting was turned over to R. L. Deppman, who distributed the awards for the day. The meeting adjourned at 9:30 p.m. Attendance 63. Attendance ratio 0.20.

• **MINNESOTA**—May 1, 1950. After dinner in the dining room of the *Minnesota Federal Savings and Loan Association* in Minneapolis, the business meeting was called to order by Pres. R. C. Jordan. The minutes of the April meeting were read by the secretary and approved. President Jordan announced that it would be necessary to elect a director to the Minnesota Federation of Engineering Societies to take the place of F. B. Rowley, who is retiring, and also an alternate to this same position. M. S. Wunderlich was elected as director and D. M. Forfar as alternate. Pres. R. C. Jordan announced the results of the election of officers for the 1950-51 season as follows: *President*—G. M. Kendrick; *Vice President*—E. F. Snyder; *Secretary*—J. V. Borry; *Treasurer*—J. G. Hamm; *Board of Governors*—H. G. Sierk and G. M. Orr.

Messrs. Alexander, Walker, Hamig, Anderson, Homan and Magney, all of whom had had a part in the heating and air conditioning system in the Minnesota Federal Building, were introduced as the guests of the evening. Mr. Alexander, the speaker of the evening, showed some very interesting slides covering details of construction of the heating and air conditioning system in the Minnesota Federal Building. After discussing the overall design of the system, the group was led through various portions of the building, and the actual equipment was studied while in operation. The meeting was adjourned at 9:45 p.m. Attendance 150.

• **MINNESOTA**—April 3, 1950. Pres. R. C. Jordan called the meeting to order at 7:55 p.m. in the Curtis Hotel and read the slate of names submitted by J. F. Stafford, chairman of the nominating committee, as nominees for officers for the year 1950-51.

G. M. Kendrick announced that the May meeting would consist of an inspection trip through the Minnesota Federal Savings and Loan Association Building to inspect the installation of an interesting air conditioning and ventilating system.

President Jordan then introduced P. J. Marschall, chief mechanical engineer of the Abbott Laboratories, as the speaker of the evening. Mr. Marschall gave an interesting talk on the design of industrial ventilating systems in regard to manufacturing problems, installation and costs. The meeting adjourned at 9:00 p.m. Attendance 100. Attendance ratio 0.37.

• **NEW YORK**—May 15, 1950. The meeting was called to order at the Building Trades Club and the minutes of the April meeting were read and approved. Pres. H. S. Johnson announced that Alfred E. Stacey, Jr., past president of the Society, and W. G. Turno, both members of the Chapter, had become Life Members in the Society, and in turn therefore had become Life Members of the New York Chapter. President Johnson introduced the officers and members of the board of governors for the year 1950-51 beginning June 1.

The meeting, which was devoted to the topic *Natural Gas Arrives in New York*, was turned over to R. L. Stinard, program chairman, who introduced H. S. Birkett, research engineer, The Brooklyn Union Gas Co., New York, N. Y. Following a brief outline of the project by Mr. Birkett, the film, *Gas Goes to Market*, was shown to illustrate the problems met and to be overcome in building a transmission line. This film showed significant details of excavation, construction, pipe insulation and means of putting the line into service.

Mr. Birkett then introduced J. B. Harshman, chief engineer, Transcontinental Gas Pipe Line Corp., who has supervision over the construction of the gas line in New York State and adjacent area. He showed a number of slides and explained the various steps taken in building a line through both rural and thickly populated areas, where means must be found to install the line without interefering with railroad and vehicular traffic.

Mr. Birkett discussed the project from the point of delivery of the gas in New York City, and outlined the work of the various gas companies which are going to use the gas. He pointed out that at least for the present, the gas will be used as an enriching agent for manufactured gas, and as such, will probably replace heavy oil, and may also cause an increased supply of coke fuel to become available in the New York area. He further stated that in all areas where natural gas had been introduced, the gas house heating load had increased very rapidly. Consideration was being given by the utilities to the possibility of obtaining summer load through air conditioning or industrial use for the purpose of compensating for the drop in gas load which would be due to the decreased demand of heating loads during certain parts of the year. He discussed some of the items which enter into the cost of gas to the consumer, and while no infor-

mation could be given on possible rates, it was emphasized that in all areas receiving natural gas, the customers had benefited in regard to cost of gas fuel.

Following a question and answer period, a rising vote of thanks was extended to the speakers, after which the meeting adjourned at 10:15 p.m. Attendance 150. Attendance ratio 0.26.

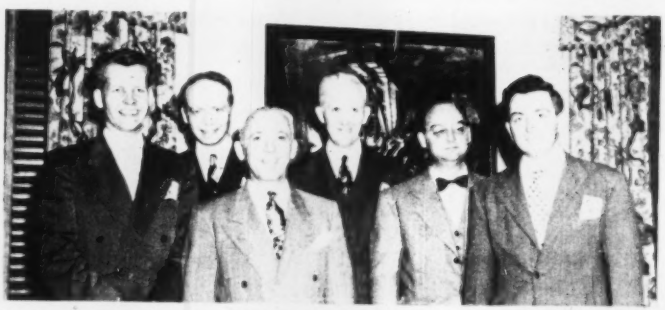
• **NORTH CAROLINA**—May 19, 1950. After a social hour and dinner served in the State Room, the formal meeting was called to order at 8:15 p.m. by Pres. M. F. DuChateau in the Hotel Robert E. Lee. Following an announcement concerning the Chapter's annual meeting and a report on the financial status of the chapter by the secretary, the meeting was turned over to J. E. Hart, program chairman, who introduced the speaker of the evening, C. M. Humphreys, senior research engineer, ASHVE Research Laboratory, Cleveland, Ohio. Mr. Humphreys' talk was on *ASHVE Research in Panel Heating* and was illustrated by slides. An informal discussion followed in which a greater part of the membership present participated. The meeting adjourned at 10:15 p.m. Attendance 32. Attendance ratio 0.25.

• **NORTH TEXAS**—April 17, 1950. Pres. Herman Blum, presiding officer, called the meeting to order at the Melrose Hotel and the minutes of the previous meeting were read and approved. President Blum introduced the speaker of the evening, E. J. Stern, district manager, Armstrong Cork Co., Dallas, Tex. Mr. Stern gave a fine, well-illustrated talk on the various types of industrial insulation for several different temperature ranges. The insulation for the various temperature ranges was illustrated, along with a brief discussion on the method of cold and hot application. He placed particular emphasis on the specification and application of insulation as applied in a multiple story installation using the summer-winter combination type of air conditioning system. He concluded with a few suggestions for the architects and consulting engineers stating that enough space should be left around equipment, piping and ducts, etc. so that it is physically possible to properly apply the insulation; the correct thickness of insulation for the dewpoint and temperature differential of the application should be specified; and the conditioned and non-conditioned spaces should be set forth clearly. According to the report of the secretary, Mr. Stern's talk was very interesting and informative and enjoyed by all present. The meeting adjourned at 10:15 p.m. Attendance 80. Attendance ratio 0.40.

• **NORTHERN OHIO**—May 8, 1950. The members and guests met in the Warner Auditorium of the Cleveland Engineering Society Building for the dinner meeting. The business meeting was called to order by Pres. R. L. Byers and the minutes of the April meeting were read by the secretary and approved. The secretary also read a message from the *ASRE* inviting the Northern Ohio Chapter members to participate in an inspection of the air conditioning and refrigeration equipment of Hall Brothers' new downtown store building on May 16. L. S. Ries, chairman of the nominating committee, presented the following slate of officers for the 1950-51 season: *President*—W. M. Rowe; *Vice President*—John Richmond; *Secretary*—G. V. Parmelee; *Treasurer*—J. M. Black; *Board of Governors*—R. E. Sherman, R. J. Maurer, R. L. Byers. It was moved that the secretary cast a unanimous ballot for the proposed nominees and the motion was seconded and passed.

C. M. Humphreys then introduced the following panel members: Prof. G. L. Tuve, moderator; J. M. Black, R. L. Byers, Alfred Koestel, H. B. Nottage, and J. J. La Salvia, who discussed the subject *Air Distribution in Air Conditioned Spaces*. Professor Tuve opened the discussion by asking each panel member to give his definition of air distribution. The give and take discussion of the subject which followed covered the definition of the term throw, the relative merits of grilles, air diffusers and perforated panels, and methods of measuring air quantities. The problem of securing balanced delivery was thoroughly discussed. Correct load calculation and careful sizing and layout of the duct work were considered to be important steps in securing good performance. Attendance 79.

• **OKLAHOMA**—May 8, 1950. The meeting was called to order by the presiding officer, Pres. H. S. Shafer, at Beverly's Drive-In. The following officers were elected to serve as



**Northern Ohio Chapter's Panel on Air Distribution** *(L. to R.)* **J. M. Black, H. B. Nottage, J. J. La Salvia, G. L. Tuve, R. L. Byers, Alfred Koestel**

follows: *President*—R. E. Swan; *Vice President*—F. X. Loeffler, Jr.; *Secretary-Treasurer*—W. J. Collins, Jr.; *Board of Governors*—W. W. Frankfurt, J. H. Spaan, Jr., H. S. Shafer.

The speaker of the evening was C. W. Wheeler, assistant sales manager, Ric-wiL Co., Cleveland, Ohio, whose subject was *Underground Conduit Systems*. An interesting discussion was held following Mr. Wheeler's talk. The meeting adjourned at 9:30 p.m. Attendance 28. Attendance ratio 0.56.

**Oregon chapter members *(L. to R.)* Dick Blankenship, T. C. Langdon, Walter Hanthorn, R. C. Chewning, W. A. Simpson, H. W. McKenzie and J. P. McDermott**

• **OREGON**—April 16, 1950. The regular monthly meeting of the Chapter was held at the Old Heathman Hotel and was called to order by Pres. J. P. McDermott at 7:00 p.m. After self introduction of those present, the minutes of the March meeting were read and approved as read. Reports were given by the various committee chairmen on the accomplishments of their committees for the year 1949-50. After a report given by T. E. Taylor, chairman of the legislative committee, on the forced air code, it was moved that the Chapter write the Commissioner of Public Works to the effect that the proposed Forced Air Code had come to the chapter's attention; that its provisions exceed those suggested by the chapter and exceed those of Ordinance 86036, authorizing the preparation of the Code; and that, therefore, the Oregon Chapter recommends the Forced Air Code be rewritten in accordance with and in the scope of the actions mentioned and that the proceedings set forth in the chapter recommendation and in the ordinance be followed prior to presentation to the city.

Percy Othus, Army Engineers, was introduced as the speaker of the evening. Mr. Othus spoke on *Flood Control of the Willamette Valley*. At the conclusion of Mr. Othus' talk, President McDermott called on J. Donald Kroeker for some comments on smoke abatement.

The officers elected for the 1950-51 season were installed as follows: *President*—R. C. Chewning; *Vice President*—H. W. McKenzie; *Secretary*—Dick Blankenship; *Treasurer*—T. C. Langdon; *Board of Governors*—W. A. Simpson, Walter Hanthorn, J. P. McDermott. The incoming President Chewning presented book ends to Mr. McDermott to signify the Chapter's appreciation for his services during his term of office as president. The meeting adjourned at 10:30 p.m. Attendance 72.

• **PACIFIC NORTHWEST**—April 10, 1950. Dinner was served at the Engineers Club at 6:45 p.m., after which Pres. J. D. Sparks called the business meeting to order at 7:30 p.m. All members and guests present were then introduced. The charter meeting of the newly formed Inland Empire Chapter at Spokane scheduled for May 5 was announced, and all Pacific Northwest Chapter members who were able were urged to attend this meeting.

The officers for the coming year were elected as follows: *President*—C. A. Pangborn; *Vice President*—R. M. Stern; *Secretary*—W. B. Pride; *Treasurer*—R. R. Kirkwood; *Board of Governors*—S. D. Peterson, R. D. Morse.

F. E. Cooper introduced the speaker of the evening, A. M. Schrieber, professor of business administration at the University of Washington. Professor Schrieber gave a very interesting talk on *Business Potentials* with an engineering approach. A discussion period followed Professor Schrieber's talk. The meeting was adjourned at 10:00 p.m. Attendance 27. Attendance ratio 0.36.

• **PITTSBURGH**—May 8, 1950. The meeting was called to order in the Assembly Room of the Fort Pitt Hotel at 7:45 p.m. The minutes of the April meeting were read and approved as read. The various committee chairmen gave their annual reports, and it was then announced that V. A. Reed, Jr. had been named a Life Member of the Society and of the Chapter. Mr. Reed was presented with a Life Membership Certificate.

H. E. Park, a past president of the Chapter, then presented a past president's button to the retiring president, H. J. Kirkendall. The meeting was then turned over to the entertainment committee which put on a show for the members and, according to the report of the secretary, every one had a good time. Attendance 43.

• **SHREVEPORT**—April 20, 1950. Pres. B. E. Segall, Jr., presiding officer, called the meeting to order at the Caddo Hotel. President Segall read a letter from the Texas A & M Student Branch regarding the employment of students during summer vacation.

S. W. Beaty, program chairman, then introduced C. A. McKinney, engineer, United Gas Corp.,

Houston, Tex., who gave a very interesting talk on proper application of gas fired appliances and equipment. The meeting adjourned at 10:00 p.m. Attendance 35.

• **SOUTH TEXAS**—April 25, 1950. Pres. R. J. Salinger called the meeting to order at Bill Williams' Restaurant, and the minutes of the preceding meeting were read and approved. A. F. Barnes reported briefly on the plans for the annual symposium of the Engineers Council. B. P. Fisher, chairman of the placement committee, appealed to the membership to help in securing employment for new graduate engineers.

The speaker of the evening, Walter Rolfe, was introduced by Reg F. Taylor, treasurer of the Society. Mr. Rolfe spoke on *An Architect Looks at Air Conditioning*, and pointed out that only through the active cooperation of the contractor, the mechanical engineer, the architect and the various other crafts and specialists on a job, could a building be constructed. He touched on the matter of space requirements for air conditioning, outlining some of the economic problems involved. Mr. Rolfe's talk, according to the report of the secretary, held the close attention of the membership. The meeting adjourned at 10:30 p.m.

• **WASHINGTON, D. C.**—May 10, 1950. The final meeting of the season was devoted to the ladies and was held in the Congressional Country Club through the courtesy of F. E. McArdle, a member of that Club and of the chapter. A social hour and dinner preceded the meeting, which was called to order by Pres. P. R. Achenbach. All of the ladies were welcomed and presented with a rose.

R. K. Thulman, chairman of the meetings committee, introduced Dr. Maria Telkes, Massachusetts Institute of Technology, whose subject was *Space Heating with Solar Energy*. Dr. Telkes, a graduate of the University of Budapest, described her experiences with a research house near Boston, which was heated by solar radiation. She explained the problems encountered and the average yearly sun exposures to be expected, and presented slides showing actual operation of the heating system in the test house. Slides showing drawings of a projected home were also shown. These featured a heating system, which consisted of a large vertical double glazed south wall backed by a black collector surface and fans which circulated the heated air. The fans, actuated by thermostats, are operated only when solar radiation is of a sufficient intensity. During periods when the sun is not shining, the chemicals give up their heat to the interior wall surfaces which act as radiators, she explained. After Dr. Telkes answered many questions concerning solar heating, she was thanked for her thoroughly enjoyable and informative presentation.

Before adjourning the meeting, F. M. Thuney, the incoming president, presented Mr. Achenbach, the retiring president, with a diamond-studded past president's button as a token of the chapter's appreciation. Attendance 122. Attendance ratio 0.42.

• **WESTERN NEW YORK**—May 8, 1950. Pres. F. J. Weber called the meeting to order in the University Club, Buffalo, at 8:15 p.m., after an excellent dinner. The minutes of the previous meeting were read and approved as read. President Weber introduced many of the past presidents, who were present at the meeting. The election of officers for the 1950-51 season was held and Mr. Weber, the retiring president turned the meeting over to J. H. Bryce, the incoming president, and thanked the officers and members for their cooperation during the past year. Mr. Bryce then outlined plans for the Chapter activities for the coming year.

The guest speaker of the evening was A. E. Stacey, Jr., Syracuse, N. Y., past president of the Society, who gave a very interesting talk on the history of the Society from its beginning, tracing its growth down to the present day. A vote of thanks was extended Mr. Stacey for his excellent talk. The meeting adjourned at 10:15 p.m. Attendance 50.

• **WESTERN NEW YORK**—April 10, 1950. The meeting was held in the University Club and was called to order by Pres. F. J. Weber at 8:20 p.m. After each member had introduced himself, the minutes of the previous meeting were read and approved as read. The meeting was then turned over to D. J. Mahoney who introduced J. R. Vernon, sales promotion manager, Johnson Service Co., Milwaukee, Wis. Mr. Vernon gave an across-the-industry presentation of the characteristics and uses of modern automatic temperature and humidity control equipment. Slides were used to illustrate instruments, applications and designs of systems. According to the secretary's report, the members agreed that the subject was ably discussed and the talk both educational and interesting. Attendance 44.

• **WISCONSIN**—May 9, 1950. Following a social hour and an informal dinner, the meeting was called to order by Pres. B. M. Kluge at the Pfister Hotel. President Kluge called upon Lester T. Avery, president of ASHVE and president of Avery Engineering Co., Cleveland, Ohio, who spoke briefly on chapter affairs. The minutes of the April meeting were read and approved and the various committee chairmen made their annual reports. The tellers of election reported that the following officers had been elected for the 1950-51 season: *President*—F. J. Nunlist; *Vice President*—H. F. Brinen; *Secretary*—N. E. Hill; *Treasurer*—J. A. Lofte; *Board of Governors*—J. R. Vernon, O. A. Trostel, B. M. Kluge. Mr. Kluge then presented the gavel to the incoming President Nunlist as a token of his office.

President Nunlist then presented Mr. Avery as the guest speaker of the evening, whose subject was *Dynamic Air Conditioning*. Mr.

Avery stated that one of the greatest hazards to industrial workers today is air contamination and that air conditioning engineers have sufficient information and resources to alleviate distress from this source. He pointed out that engineers can rid the air of germs, dust, pollens, gases and vapors, and that they can control the quality of the air as to temperature and humidity to the extent that they can now produce air of any desired condition or purity. He encouraged the use of this knowledge and methods to curb the tremendous waste and discomfort caused by contaminated air. Mr. Avery quoted many outstanding authorities and gave statistics to describe and emphasize the salient points of his talk. The talk was accompanied by some very interesting slides showing industrial air conditioning systems and methods.

The talk was very well received by the members and guests and Mr. Avery was given a rising vote of thanks after which the meeting was adjourned at 9:54 p.m. Attendance 54.

• **WISCONSIN**—April 17, 1950. The April meeting of the Wisconsin Chapter was held in the auditorium of the Mechanical Engineering Building at the University of Wisconsin and was formally called to order by Pres. B. M. Kluge. An inspection trip through the new Mechanical Engineering Building in the afternoon and dinner at Rohde's Steak House preceded the evening meeting. President Kluge introduced Prof. G. L. Larson who then introduced Prof. M. O. Withey, Dean of the College of Engineering at the University. Dean Withey welcomed the Chapter and spoke briefly about the future expansion plans of the Engineering Department at the University.

Professor Larson then introduced the speaker of the evening, S. R. Lewis, consulting engineer from Chicago, whose subject was *How to be a Better Consulting Engineer*. Mr. Lewis related many of the high spots in his long career in the heating, ventilating and air conditioning industry. He described incidents and experiences he has had with boiler plants, radiant heating, various fuels, blast coils, sheet metal work, filters, traps and controls. He suggested recommendations for the application of these various items of equipment and offered solutions to problems in connection with them; solutions drawn from his actual experience.

After a brief discussion period, a rising vote of thanks was extended to the speaker for his interesting talk and the meeting adjourned at 9:40 p.m. Attendance 66.

## STUDENT BRANCHES

▲ **TEXAS A. & M.**—April 24, 1950. The meeting was called to order by Pres. J. E. Schumann in the Mechanical Engineering lecture room at 7:30 p.m. W. E. Richard introduced the guest speaker for the evening, F. W. Rabe, consulting engineer of Dallas, Tex., who spoke on the practical aspects of cooling towers. A short question and answer period followed his talk. Attendance 35. Attendance ratio 0.50.

▲ **UNIVERSITY OF DETROIT**—May 4, 1950. Pres. L. M. Blanchette called the meeting to order at 8:15 p.m. The following members of the Society participated in the panel discussion which was planned for the meeting: Lester Mauer, mechanical engineer, Giffels & Vallet, Inc.; K. J. Wagoner, sales engineer, The Trane Co.; E. F. Glanz, Glanz and Killian Co.; E. F. Hyde, Hyde and Bobbie; and L. A. Burch, past president of the Michigan Chapter and vice president and chief engineer, R. L. Deppman Co. Mr. Maurer covered the architectural and engineering phase of the industry; Mr. Wagoner the sales phase and Mr. Glanz the contracting division. Mr. Burch and Mr. Hyde participated informally and added their personal experiences in the industry. Mr. Hyde also revealed his efforts to arrange for interviews between graduates and possible employers. A point of primary interest discussed by each of the participants was the availability of positions in the industry at the present time.

A question and answer period followed the panel discussion and the meeting was adjourned at 10:00 p.m. Attendance 14. Attendance ratio 0.51.

▲ **UNIVERSITY OF TEXAS**—May 6, 1950. The meeting, which was the annual meeting celebrating the Charter Presentation, was held at the Avalon Club in Austin. It was a dinner meeting and ladies and guests were invited. The speaker of the evening was W. R. Woolrich, Dean of the College of Engineering at the University who spoke on *America's Power*. Dancing followed and according to the report of the secretary, the meeting was enjoyed by all present. Attendance 50.

## MISS HICKS, ASHVE MEMBER, ELECTED PRESIDENT OF *SWE*

Miss Beatrice A. Hicks, vice president of Newark Boiler Regulator Co., Bloomfield, N. J. and Associate Member of ASHVE, was elected

**Beatrice A. Hicks**
**Bloomfield, N. J.**

president of the *Society of Women Engineers* at its annual convention on May 27, 1950.

Miss Hicks, born in 1919 in New Jersey, obtained her B.S. in chemical engineering from Newark College of Engineering in 1939, and her M.S. in physics from Stevens Institute of Technology in 1949.

From 1939 until 1942 Miss Hicks was a research worker at Newark College of Engineering. In 1942 she

joined the Western Electric Co. at Kearny, N. J. After some months in test set design, she transferred to work in quartz crystal production, and contributed substantially to dimensional development.

She is also a member of the *Institute of Radio Engineers*, and is a registered professional engineer in New York and New Jersey.

## KOCH NAMED MID-ATLANTIC MANAGER

Albert H. Koch, a member of ASHVE, has been named manager of the mid-Atlantic region for Minneapolis-Honeywell Regulator Co., with headquarters at Philadelphia. This region will comprise Philadelphia, Washington, Baltimore and Richmond territories.

A graduate of Stevens Institute of Technology, he joined Minneapolis-Honeywell in 1929 after previous employment as an engineer for the Consumers Power Corp. and the M. W. Kellogg Co. He has worked in the Cleveland and Atlanta offices of the company and was most recently branch manager of the Philadelphia office.

**A. H. Koch**
**Philadelphia, Pa.**

## K. B. LITTLE HONORED IN CINCINNATI

Kenneth B. Little, representing the ASHVE on the *Technical and Scientific Societies Council of Cincinnati*, has been elected secretary-treasurer for the 1950-51 season. He was a member of the Coordination Committee in 1949-50. An active member of the Society's Cincinnati Chapter, he served as president, vice president, secretary-treasurer, and member of its board of governors. He is owner of Kenneth B. Little Co.

## T. I. BYRD IN NEW POST

Thomas I. Byrd has been elected vice president in charge of sales of The Lau Blower Co., Dayton, Ohio, according to an announcement from E. B. Lau, president of the company. Mr. Byrd was sales manager with the company since 1943 and previously was department manager in the Market Development Division of Armco Steel Corp. Mr. Byrd is well known in the industry and has had years of experience and has many contacts in the heating and air conditioning field. He has been a member of ASHVE for over 14 years.

**T. I. Byrd**
**Dayton, Ohio**

# *Candidates for Membership*

The Constitution of the Society, as now amended, requires the following mode of procedure in voting on applicants for membership in the Society. All applications for membership are to be sent to the Executive Secretary and the names of applicants and their references shall be printed in the next issue of the JOURNAL of the Society or sent to the members in other approved manner as ordered by the Council. When the replies are received from references, the Candidate's application shall be submitted to and acted upon by the Admission and Advancement Committee as soon as possible.

When the Admission and Advancement Committee has acted favorably upon a Candidate's application and assigned his grade, the Council shall vote upon the election of the proposed Candidate for membership by letter ballot. During the past month, 115 applications for membership have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Admission and Advancement Committee, and in turn, the Council, urge members to assume their share of responsibility of receiving these candidates into membership by advising the Executive Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by July 25, 1950, these candidates will be balloted upon by the Council. Those elected to membership will be notified by the Executive Secretary immediately after election.

ALLEN, R. C., Designer, W. H. Kiefaber Co., Dayton, Ohio. REFERENCES: W. J. Killian, K. B. Little, R. J. Perkins, C. D. Weaver.

BARR, J. W., Sales Engr., Allis-Chalmers Mfg. Co., Charlotte, N. C. REFERENCES: E. S. deWitt, J. G. Johnson, Jr., R. O. McGary, R. M. Warren, Jr.

BARR, W. N., JR., Sales, Warren Barr Supply Co., Chicago, Ill. REFERENCES: A. M. Bladen, O. J. Cook*, C. E. Pullum, R. L. Wood*.

BATT, W. R., Engr., A. R. Salzer, Jr., Mech. Engr., New Orleans, La. REFERENCES: J. J. Friedler, Jr., W. H. Grant, Jr., R. B. Guest, A. R. Salzer, Jr.

BRONSKI, S. S., Engr., The George Ellis Co., New Haven, Conn. REFERENCES: R. R. Humbert*, B. M. Packtor, Grant Robley*, L. W. Shepard.

BROOKE, R. J., Chief, Refrigeration, Air Conditioning & Ventilation Branch, Third Army Staff, Fort McPherson, Ga. REFERENCES: Sydney Anderson, Jr., H. L. Baker, Jr., L. L. Barnes, F. W. Clare.

BUDDEMEYER, H. J., Industrial Gas Engr., Dayton Power & Light Co., Dayton, Ohio. REFERENCES: C. L. Gillum*, R. J. Perkins, C. D. Weaver, N. L. Woolley.

*Non-member

BYER, A. H., Mgr., Detroit Mfg. and Supply Co., Detroit, Mich. REFERENCES: W. A. Brown, T. L. Osberger, E. M. Tennant, W. L. Tuck.

CARLSON, A. B., Air Conditioning & Refrigeration Engr., Minnesota Mechanical Co., Minneapolis, Minn. REFERENCES: A. B. Algren, E. J. Burns, W. N. Parks, W. F. Uhl.

CARNES, ALBERT, Chief Engr., Metropolitan Greenhouse Manufacturing Corp., Brooklyn, N. Y. REFERENCES: N. A. Degen*, M. I. Jacobs*, Saul Jacobs*, John Stoedter*.

CHAPPUIS, A. C., JR., Sales Engr., Edward E. Sprangley & Co., New Orleans, La. REFERENCES: A. J. Mayers, Jr., B. M. Payne, E. E. Spranley, C. S. Woodruff.

COHN, M. M., Pres., Cohn & Kramer, Inc., Albany, N. Y. REFERENCES: H. A. Bond, P. E. Kavanagh, R. B. Taylor, Wendell Westover.

COULON, B. J., Sales Mgr. & Vice-Pres., Rumbold & Co., Atlanta, Ga. REFERENCES: William Crenshaw*, L. F. Kent, Lon Shehan*, M. W. Wise.

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# OBITUARIES

## W. E. GOODRAM
### Hamilton, Ont., Canada

A well known heating and ventilating contractor in Hamilton, Ont., William Earnest Goodram, president and general manager of Goodram Bros., Ltd., died on Thursday, May 4, 1950 at his home on Lake Shore Highway, Port Nelson.

Mr. Goodram was born in Hamilton, March 29, 1889, and resided in this district all his life. He started in the heating and plumbing business 44 years ago, after serving his apprenticeship with his brother. Later they formed the firm of Goodram Bros. He was a successful member of the trade and well known throughout Ontario for many large heating and ventilating installations. He was a distributor for Iron Fireman Mfg. Co. and Carrier Corp.

Mr. Goodram, a member of the Society for over 10 years, also belonged to the Hamilton Rotary Club, the Thistle Club and the Burlington Golf & Country Club. He was also a member of Acacia Lodge A. F. & A. M.; Murton Lodge of Perfection; Rose Croix and Moore Sovereign Consistory; Rameses Temple; and Hamilton Shrine Club.

Surviving besides his wife, the former Emma Marguerite Wilson, are a son, Robert Maitland Goodram; a daughter, Miss Mary Goodram; and two brothers, Robert and Fred, both of Hamilton.

## EDGAR R. ROBINSON
### Camden, New Jersey

Edgar R. Robinson, a member of ASHVE since 1938, died on May 25, after a long illness. Mr. Robinson was a plant construction and layout engineer for RCA Victor Div., Radio Corp. of America.

He was born in Framingham, Mass., on May 27, 1897, and graduated from the University of Michigan in 1923 with a B.S. in electrical engineering. From 1923-27 he was a junior engineer with the Central Railroad Co., Chicago, where he was connected with the development of electric ignition and spray nozzles for low pressure oil burners. In 1927-29 he was research assistant and chief engineer for Gulf Oil Burner Co., Philadelphia, where he had supervision of sales engineers and took charge of local installation and service work. Since 1929 Mr. Robinson was an engineer with Western Electric Co., Kearny, N. J.; General Air Conditioning Corp., Baltimore, Md. as engineering manager; Paul J. Vincent Co., Baltimore, as a sales engineer; Pen Mar Co., Baltimore, as heating engineer and sales manager; May Oil Burner Corp., Baltimore, as research and development manager; and six years with the New York Shipbuilding Corp. as senior draftsman.

Mr. Robinson is survived by his widow of Westmont, N. J.

## GEORGE P. JACKSON
### Chicago, Ill.

George P. Jackson, a member of ASHVE, died in Augustana hospital on April 16. He was born on January 29, 1903 in Chicago and received his education there. As a mechanical and electrical engineer, Mr. Jackson joined D. W. Gawne & Co. as a partner from 1937 to 1941. In 1942-43 he became assistant chief electrical engineer with M. J. Boyle & S. A. Healy, Carbondale, Ill. From 1943 till the time of his death, Mr. Jackson was employed as mechanical and electrical supervisor for George A. Fuller Co., Chicago, Ill.

Mr. Jackson was also a member of the *American Institute of Electrical Engineers*.

Funeral services for Mr. Jackson were held on April 19 in a chapel in Oak Park and the burial took place in Oak Ridge Cemetery. Surviving are his widow, Mrs. Irene M., and two daughters, Carol and Diane.

# IN MEMORIAM

## Dr. E. Vernon Hill

## 1876 - 1950

Dr. E. Vernon Hill, a Life Member and Past President of the ASHVE, died on May 15 in the University of Illinois Research Hospital at the age of 72. Dr. Hill, a physician, scientist, engineer, and a recognized authority in the science of aerology, was born on October 25, 1876, in Jamestown, Pa., and received his high school education at Andover High School, Andover, Ohio. Following his graduation, he became construction engineer for the New York Central Railway, which position he held until 1899. In 1899 he matriculated in chemistry at the University of Illinois, later attending Rush Medical College, Chicago, from which he was graduated in 1903 and then began the practice of medicine.

Dr. Hill was appointed medical inspector of the Chicago Board of Health in 1904 and the following year was certified as a sanitary inspector for the department. In 1912 he was made chief of the ventilation division of the Chicago Department of Health, and in 1917 was appointed chief of the department's sanitary bureau. He resigned from the health department to enter private consulting practice in 1922 and became active in the heating, ventilating, and air conditioning field. Since that time, Dr. Hill devoted himself to aerology and was the editor and owner of the *Aerologist*. Later he became interested in instrumentation and devoted some time to making instruments for air measurement and analysis.

Dr. Hill became active in Society affairs in 1912 and he served as second vice president

Dr. E. Vernon Hill

in 1918, first vice president in 1919 and president in 1920. He served on the Society's Council from 1915 to 1921 and as a member of numerous technical committees. He was president of the Illinois Chapter in 1917 and 1918 and on the Chapter's Board of Governors in 1919. His wide interests and the extent of his services to the Society are indicated by the record of membership on the committees on which he served. Among these were the following:

1915-20 Special Committee to Recommend a Standard Method for Testing Air Washers (Chairman in 1915)
Publication Committee
Committee on Charters for New Chapters
Committee on Engineering Cooperation
Committee to Cooperate with U. S. Navy Department
Finance Committee

1921-25 Committee on Research
Sub-Committee on Subjects
Committee on Revision of Constitution (Chairman-1924)
Sub-Committee on Dust (Chairman in 1922)
Sub-Committee on Ventilation Requirements for Public Buildings (Chairman-1923-25)
Committee on Synthetic Air Chart
Committee to Consider Report of New York State Commission on Ventilation
Committee on Ventilation Standards

1926-30 Committee on Research (1926)
TAC on Temperature, Humidity and Air Motion
Guide Publication Committee
Committee to Cooperate with Rochester School Board
Committee on Standards of Ventilation
Sub-Committee on Ventilation Requirements for Public Buildings (Chairman 1926-28)
TAC on Atmospheric Dust and Smoke
TAC on Air Cleaning Devices
TAC on Air Conditions and Their Relation to Health
Committee on Code for Minimum Requirements for the Heating and Ventilation of Buildings

1931-35 TAC on Air Conditions and Their Relation to Living Comfort
TAC on Atmospheric Dust and Air Cleaning Devices (Including Dust and Smoke)
TAC on Re-Study of Comfort Chart and Comfort Line
TAC on Air Conditioning in Treatment of Diseases (Chairman 1935)
TAC on Comfort Standards for Summer Cooling (1935)
Special Committee on Ventilation Standards

1936-39 TAC on Air-Conditioning in the Treatment of Diseases (Chairman 1936)
TAC on Psychrometry
TAC on Relation of Body Changes to Air Changes (Chairman 1937)

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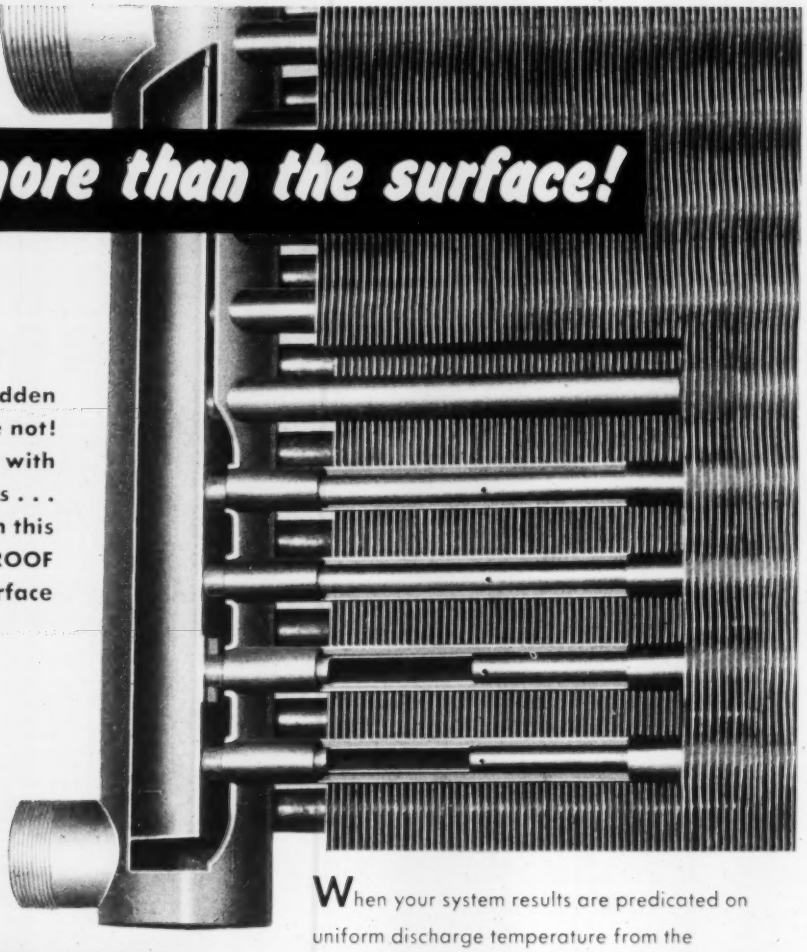
City: Zone: State:

# Buy more than the surface!



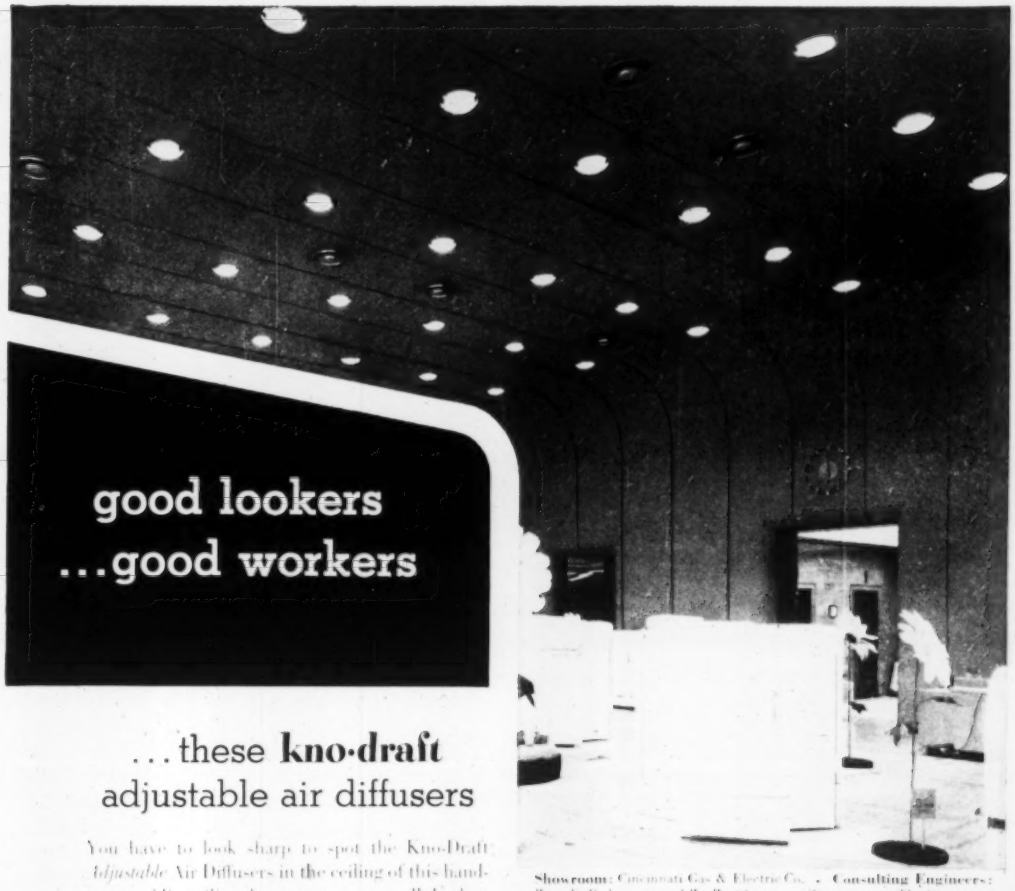
**Surface is hidden but results are not! Don't gamble with inferior coils . . . Insist on this Nesbitt FREEZEPROOF Heating Surface**

# NESBITT
## *Series D*
# HEATING SURFACE
## WITH
## Steam-Distributing Tubes

When your system results are predicated on uniform discharge temperature from the heat transfer surface, you must KNOW that the surface you specify will DELIVER . . . So you must look beneath the surface for the best assurance there is that even small amounts of steam under modulated control will be distributed UNIFORMLY over the entire coil. You find it in the steam-distributing tubes of Nesbitt Series D Heating Surface . . . orificed tubes within the condensing tubes . . . an original Nesbitt application that has been tested and proved in thousands of installations. Would you like Publication 247?

**NESBITT ALSO MANUFACTURES:** Series W Water Surface **Type WD** with exclusive drain feature, **Type WB** for booster heating and air cooling—Pub. 246; **Type WC** with removable headers—Pub. 255. Series H Surface for general air heating—Pub. 248.

**MADE AND SOLD BY JOHN J. NESBITT, INC.**
Philadelphia 36, Pa.
NEW YORK • NEWARK • CHICAGO • ATLANTA • DALLAS



# good lookers ...good workers

## ...these **kno·draft** adjustable air diffusers

You have to look sharp to spot the Kno-Draft *Adjustable* Air Diffusers in the ceiling of this handsome public utility showroom . . . so well do they blend in with the architect's design for lighting.

Yet these good lookers are good workers, too. None better, in fact. Kno-Draft *Adjustable* Air Diffusers circulate the air gently and evenly . . . without drafts to bother persons on the floor . . . without differences in temperature between one spot and another.

This pattern of air flow—both its volume and direction—can be adjusted *after* installation. A few turns of a screw driver thus replace lengthy slide rule calculations.

**Showroom:** Cincinnati Gas & Electric Co. . **Consulting Engineers:** Wm. E. Badenhop and W. W. Shuster . **Contractor:** The Cincinnati Air Conditioning Company

You can paint Kno-Draft *Adjustable* Air Diffusers or leave them in their natural aluminum . . . whichever goes best with the established decorative theme. You can get them in suitable types and sizes for every job.

**KNO-DRAFT DATA BOOK:** Complete specifications, engineering and installation data on Kno-Draft *Adjustable* Air Diffusers. To get your copy, simply fill in and mail the coupon. No obligation, of course.

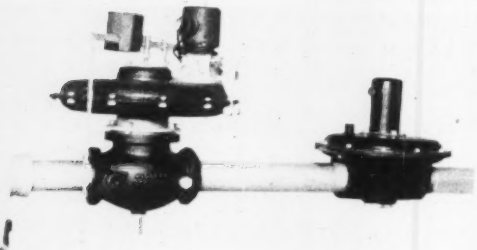
W. B. CONNOR ENGINEERING CORP.
114 East 32nd Street, New York 16, N. Y.
*Air Diffusion • Air Purification • Air Recovery*
In Canada: Douglas Engineering Co., Ltd.,
190 Murray Street, Montreal 3, P. Q.

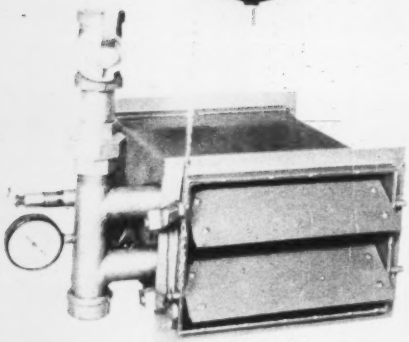
W. B. CONNOR ENGINEERING CORP.
Dept. G-70, 114 East 32nd Street, New York 16, N. Y.

Please send me without obligation, my copy of the Kno-Draft Air Diffuser Data Book.

Name .....
Position .....
Company .....
Street .....
City ..... Zone ..... State .....

# John Zink's New Series STV GAS BURNER





## Ideal for Heating Boiler Installations

FROM 1 TO 50 HEADS

•

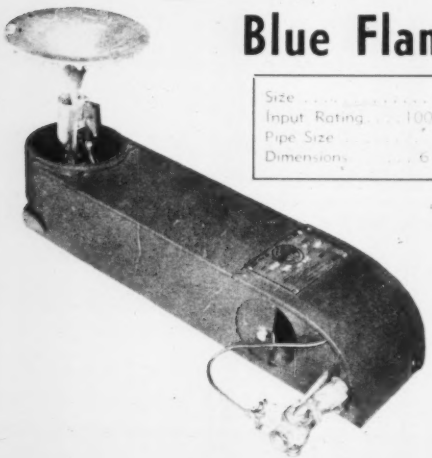
QUIET

EFFICIENT

ECONOMICAL

---

## Blue Flame Conversion Gas Burner



| | |
|---|---|
| Size | VR-200 |
| Input Rating | 100,000-200,000 Btu |
| Pipe Size | ¾" |
| Dimensions | 6¼" x 8¼" x 36" |

This is the John Zink VR-200 Blue Flame Conversion Gas Burner. Notice that the controls are concealed in a neat, attractive hammer finish cabinet which is easy to keep clean. You have a fully automatic burner in a complete packaged unit.

- One Universal Size
- Economical
- Safe
- Efficient
- Clean, Healthful Heat
- A. G. A. Certified
- Fully Automatic
- For Natural, Mixed or Manufactured Gas

# JOHN ZINK COMPANY

4401 SOUTH PEORIA — TULSA, OKLAHOMA

# WORTHINGTON AIR CONDITIONING REPORT

WORTHINGTON PUMP AND MACHINERY CORPORATION
HARRISON, NEW JERSEY

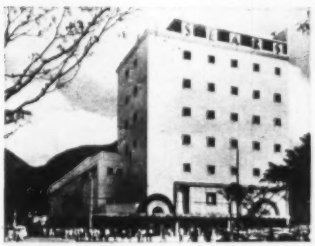
*Specialists in air conditioning and refrigeration for more than 50 years*

## Cool Sears Gets Warm Reception In Rio

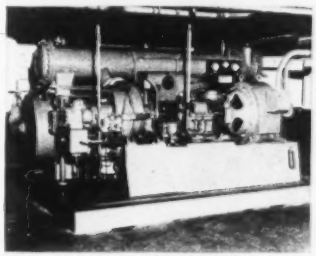
It was practically a fiesta day when Sears, Roebuck and Co. opened its new retail store in Rio de Janeiro.

At dawn before the opening the lines had formed, and before the day was through, 125,000 Brazilians had stormed the premises. First day's receipts were in excess of $500,000.

Among the attractions in this new Sears store is Worthington air conditioning, a welcome feature in Rio's



*Sears, Roebuck store at Rio de Janeiro, Brazil, is air conditioned by means of Worthington centrifugal refrigeration.*



*Worthington centrifugal compressor in Sears, Roebuck's Trenton, New Jersey, store.*

semi-tropical summers. Chilled water for the air conditioning is supplied by a 55C66 centrifugal refrigeration system.

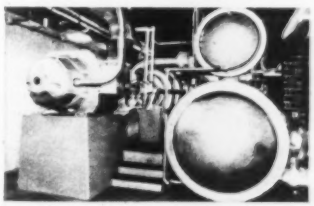
Meanwhile, another Sears store, closer by in Trenton, New Jersey, was being equipped with Worthington air conditioning, joining other Worthington-equipped Sears stores in Allentown, Pa., Atlanta, Ga., Kansas City, Mo., and Knoxville, Tenn.

## How Insurance Company Insures Employee Morale

One of the biggest insurance companies in the country believes in insuring the happiness and efficiency of its personnel through air conditioning.

The new addition to the beautiful Omaha, Nebraska, home of the United Benefit Life Insurance Company, and its affiliates, is air conditioned through-

*Home office of the United Benefit Life Insurance Co., Omaha, Nebraska.*



*Worthington 75C99 centrifugal compressor at United Benefit Life Insurance Co.*

out by a Worthington 75C99 centrifugal compressor with 727 ton capacity. This unit chills water, which is sent to air washers to control the temperature and humidity of the air, which is then distributed throughout the building. *Engineer: Charles S. Leopold, Philadelphia.*

## Oilmen Strike It Lucky

In the heart of the "oil country," at Garland, Texas, an up-to-the-minute new plant has been opened by Emsco Derrick and Equipment Company to provide oilmen with the latest in such essential equipment as sucker rods, deep well plunger pumps, etc.

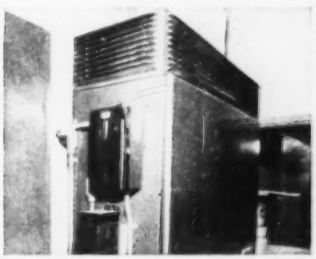
For greater comfort of visitors and employees, as well as peak performance, the finest air conditions are main-

*Modern new plant of Emsco Derrick and Equipment Company at Garland, Texas.*

tained in the offices, laboratories and engineering rooms by Worthington equipment.

The large area of the main office is serviced by a 5HE6 Freon-12 compressor unit with an ECZ-501 evaporative condenser, and an AHY-501 Air Conditioning unit. Two SCY package air conditioners, designed for compact areas, cool the small offices in the shop section.

*Architect: Donahue and Cheek, Dallas*

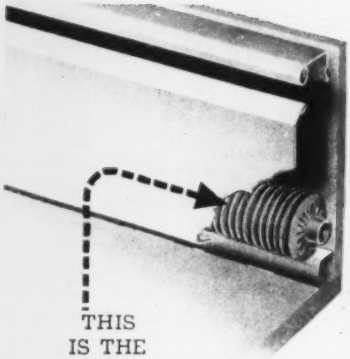


*Worthington package air conditioner at Emsco.*

**WORTHINGTON**

**AIR CONDITIONING AND REFRIGERATION**

A complete line . . . in which all the vital components are made, not just assembled by Worthington. For more worth with Worthington, see your nearby Worthington distributor (consult Classified Telephone Directory).



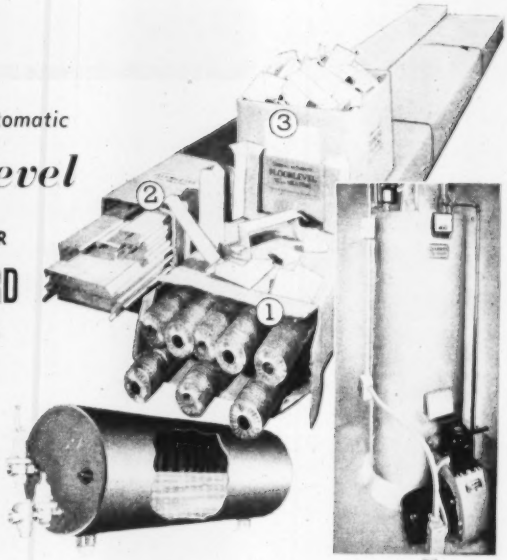

General Automatic

# *floorlevel*

HOT WATER

# BASEBOARD

RADIATION




## *all in one easy-to-sell heating package!*

For use with all types of hot water heating systems. Easy to handle, easy to store, easy to sell, easy to install. Package includes de-airator tank, circulator, flow control valve, oil-fired boiler-burner unit . . . at great saving.

DE-AIRATOR TANK

A positive air eliminator on hot water systems.

"J" SERIES BOILER-BURNER UNIT

## *the complete line built to* BUILD DEALER PROFITS...

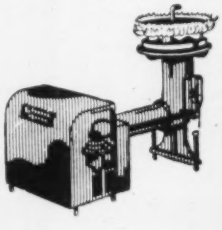
GAS FIRED WARM AIR FURNACE

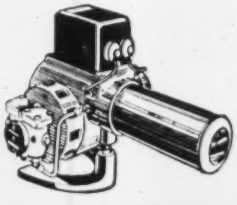
AGA approved 57,000 - 142,500 BTU hr. input

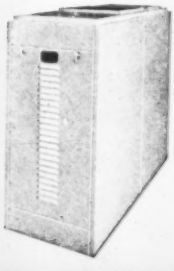
Write for our popular dealer program. Customers who want *sure* comfort want General Automatic. Let your customers select from our complete line of oil and gas fired heating equipment.

## . . . IN BOTH OIL & GAS!

CONVERSION BURNERS (Oil or Gas) feature low cost, quick installation. Immediate delivery.







OIL FIRED WARM AIR CONDITIONERS

Lowboy (illustrated) from 85,000 to 200,000 dTU Highboy, space saver, up to 85,000 Btu (not illustrated)

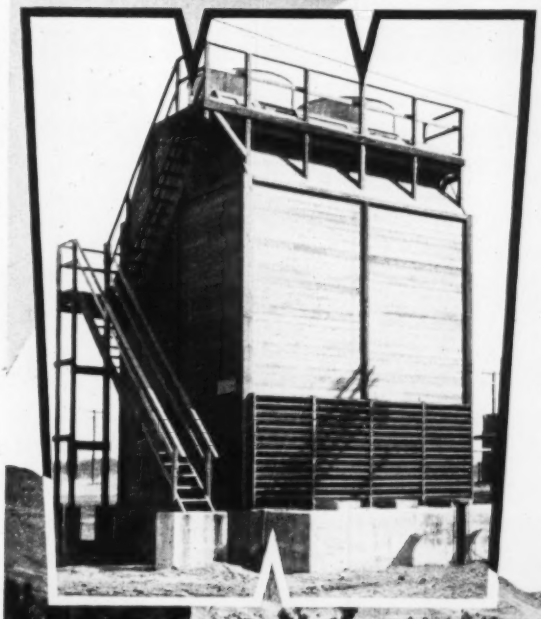
Since 1923

GENERAL Automatic

**General Automatic Products Corp., 2300 Sinclair Lane, Baltimore 13, Md.**

# WATER'S TOO SCARCE and COSTLY to WASTE

## Save it with a C. H. W. Cooling Tower



Look how much this source of water has dried up! And this is no exception, either. More and more plants are feeling the "pinch" in water supply. Industrial expansion, plus higher domestic use, has overtaxed supply in many areas. Good surface water sources are low and, in areas where there is plenty, the quality is poor and costly to make usable. Although sufficient underground water deposits exist,* it will be several years before they can be tapped. All this means that you'll have to get the most out of what you have, or face production cuts or even a shutdown. But there is something you can do—use a C. H. W. cooling tower for operations requiring cooled water, thus permitting use of the same water over and over again. And you'll find that a C. H. W. cooling tower will not only save water and its cost, but also that cooling performance is guaranteed. For any operation requiring cooled water—chemical, processing, petroleum, air conditioning, etc.—check on a C. H. W. cooling tower first. Write for literature.

*According to Government surveys

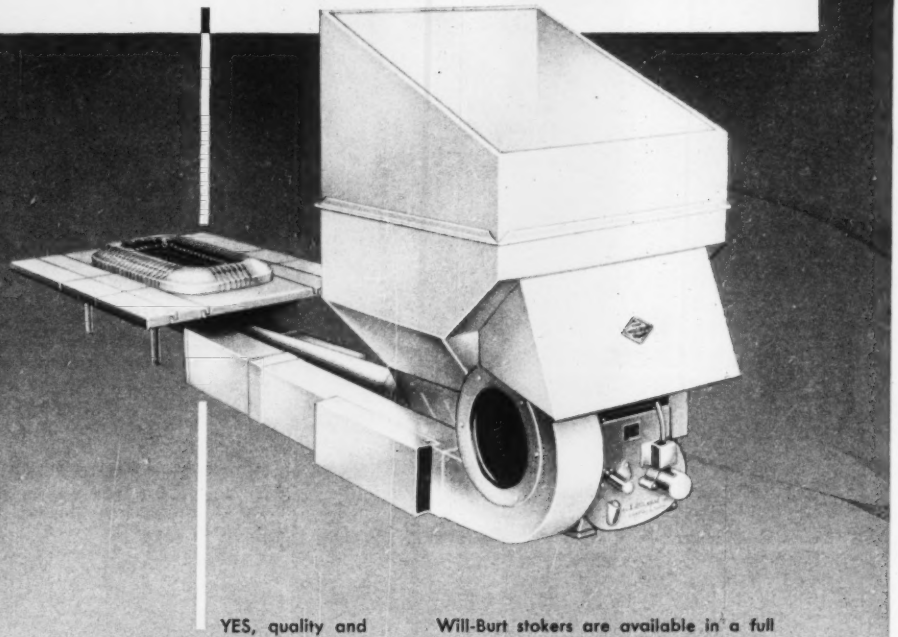
**C. H. WHEELER MANUFACTURING CO.**
1826 Sedgley Ave., Philadelphia 32, Pa.
REPRESENTATIVES IN MOST PRINCIPAL CITIES

**C. H. Wheeler** OF PHILADELPHIA
SINCE 1903

DECK MACHINERY · STEAM CONDENSERS
STEAM JET AIR EJECTORS

*Quality-wise* means PROFIT-WISE...

that's why WILL-BURT means MORE PROFIT



YES, quality and profit go hand-in-hand—for only by providing products of the highest quality can a heating contractor, dealer or distributor hope to develop the good will which makes his customers recommend him to their friends.

That's why Will-Burt heating folks "stay put"—because the quality of Will-Burt stokers and other heating products keeps customers happy—and because Will-Burt's time-tested dealer policy is friendly, helpful, considerate.

Will-Burt stokers are available in a full range of styles and sizes, in capacities up to 600 pounds per hour. Backed by more than 50 years of manufacturing experience—more than 20 years in designing and manufacturing bituminous coal stokers—a Will-Burt stoker will provide the safe, sure, efficiency you'll need for your next installation.

May we send you more information?

**OTHER WILL-BURT HEATING PRODUCTS**

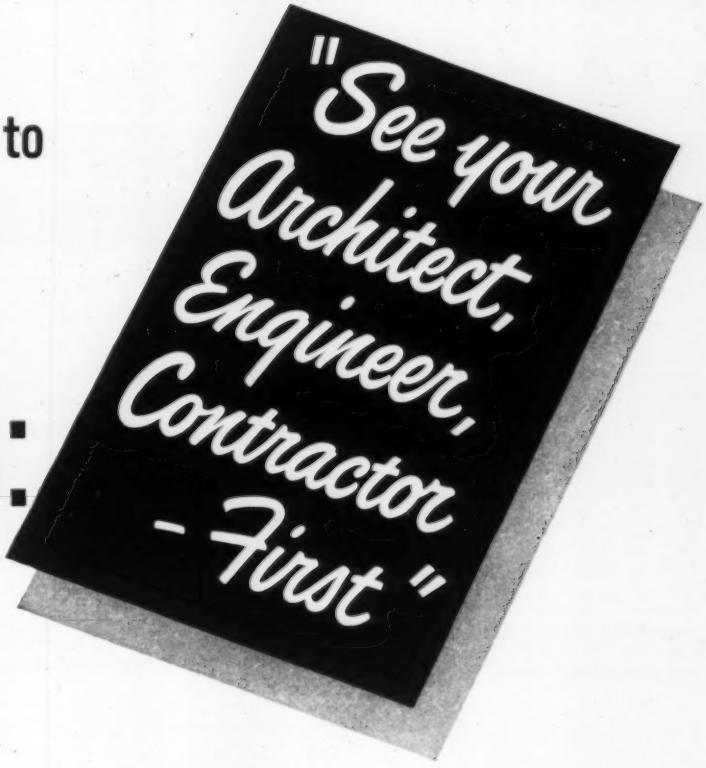
Oil and gas conversion burners.
Residential hot-water heating boilers.
Coal, gas and oil-fired warm-air furnaces.

WILL-BURT

**THE WILL-BURT COMPANY**

**DEPARTMENT H ORRVILLE, OHIO**

# This is York's advice to Your Clients:




*York gives you unequaled support in providing the finest central station systems possible through this Nine-Point Plan . . .*

- a complete line of equipment
- competitive prices
- accurate, dependable product ratings
- technical assistance based on "case histories"
- cooperation with architects, engineers and contractors
- practical help from York-trained engineers
- a national organization
- continuous product research and development
- certified maintenance

York believes that channeling contract work through you is the soundest method of assuring better air conditioning for your clients.

That's why a York-trained air conditioning and refrigeration engineer is available to work with you from the "idea" to the final installation phases of any of your jobs.

Beyond doubt his experience-sharpened, specialized knowledge will save you hours of tedious "desk- and drafting-time" in preliminary planning and specifications work.

Behind the technical counsel of the York engineer lie thousands of successful York installations in every type of business and industry, *plus a thorough* knowledge of York's complete line of refrigeration and air conditioning products.

But more—to save you from post-installation headaches and time-consuming chores, York offers its Certified Maintenance Plan. A unique service that assures over-the-years continuous operating efficiency and peak installation performance—at costs that are determined in advance.

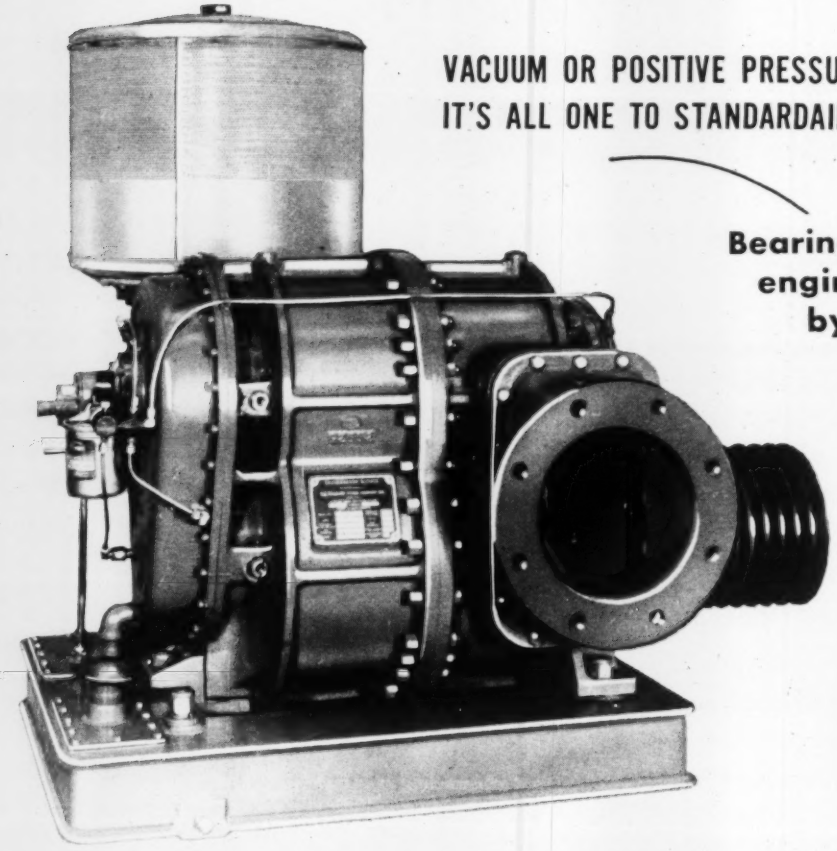
The York-trained engineer is able, fully qualified. And York products are backed by seventy-five years of production know-how and engineering advances. Check with your nearest York District Office to save time in design and detail work on your next tough job. York Corporation, York, Pa.

York refrigeration air conditioning

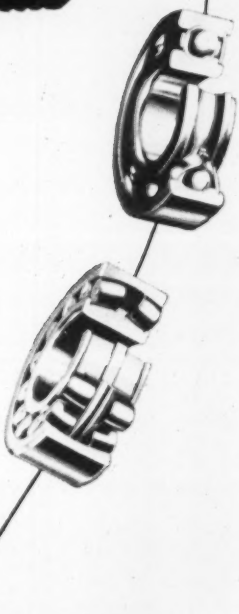
**The big advances come from YORK**

*Headquarters for*— **Refrigeration and Air Conditioning**

## VACUUM OR POSITIVE PRESSURE... IT'S ALL ONE TO STANDARDAIRE BLOWERS



**Bearings engineered by SKF**



The Standard Stoker Company, Inc., builds Standardaires . . . compact machines that handle gas or air under pressure or vacuum from 20 cfm to 15,000 cfm. They're lightweight, operate at high speed and efficiency, and they're widely used not only for air conditioning but for such applications as cupola blowing, in chemical processes, for mine ventilation, in waterworks plants and for vacuum systems. Everywhere, they've earned a reputation for full dependability . . . a reputation that's aided by SKF Bearings. SKF Spherical Roller Bearings are used on the "held" end of each shaft and in the pulley, SKF Single Row Deep Groove Ball Bearings, with one shield, on the "free" end of each shaft. Wherever uninterrupted, trouble-free operation is a prime consideration, it's wise to consider SKF Ball and Roller Bearings.

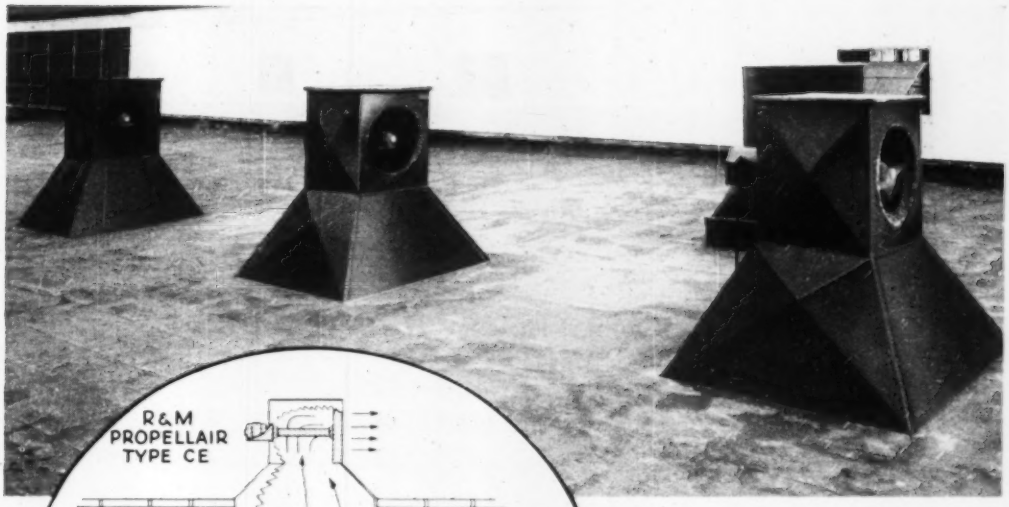
**SKF** INDUSTRIES, INC., PHILADELPHIA 32, PENNSYLVANIA — *the Pioneers of the Deep Groove Ball Bearing, Spherical Roller Bearing, Self-Aligning Ball Bearing.*

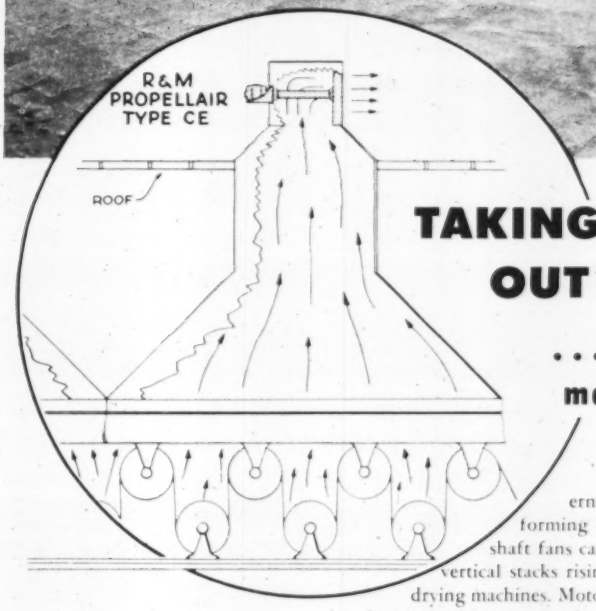
**SKF**

**BALL AND ROLLER BEARINGS**

8 REASONS WHY **SKF** IS PREFERRED BY ALL INDUSTRY

Integrity · Craftsmanship · Metallurgy · Tolerance Control · Surface Finish · Product Uniformity · Engineering Service · Field Service






# TAKING THE STEAM OUT OF THE ROLLER

## . . . PROPELLAIR helps make "paper profits" real

It was a familiar problem to Propellair engineers—moisture removal. A large Eastern paper manufacturer was troubled by steam forming over drying rolls. Sixteen R & M extension shaft fans came to the rescue. These fans are mounted in vertical stacks rising out of the hoods surrounding the paper-drying machines. Motors are mounted outside the stacks away from dampness. Many tons of moisture are removed daily by this set-up.

## PROPELLAIR FEATURES

Blades are actual airfoils, give greater efficiency. Perfection of entrance housing lowers entrance losses. All motors carefully constructed for fan duty applications. Special moisture-proof, explosion-proof and glass-insulated motors on request.

## VARIETY AVAILABLE

Propellair comes in many sizes and designs to give top performance for any application. Our engineers will advise you on installation of extended shaft, direct-connected, belt-drive, cradle-mount, pedestal-mount. Propellair provides the economical, efficient solution to all ventilating problems.

**PROPELLAIR**

DIVISION OF ROBBINS & MYERS • INC.

SPRINGFIELD 99 OHIO

WRITE, WIRE OR PHONE FOR DETAILS

# Is your company ringing the bell

## FOR EVERYONE'S FINANCIAL INDEPENDENCE?

We all can help keep our country economically strong by pulling strongly in the Treasury Department's Independence Drive, May 15-July 4. Obviously this is important to you, because what's good for the nation is good for you and your company.

The purpose of this drive is to increase everyone's financial independence through the regular purchase of United States Savings Bonds. Your "pull" is needed because the greatest share of Series E Bond sales are made through the Payroll Savings Plan—and the Plan (now used by 21,000 companies) thrives best in any company when it gets top management's personal sponsorship.

If your company doesn't have the Payroll Savings Plan, now is certainly the time to install it! It's good "employee relations" to provide this convenience.

If your company does have the Plan, now's the time to put extra push behind it! Employees who pile up money in Savings Bonds feel more secure . . . are actually better workers. Moreover, Bond sales build a backlog of future purchasing power—good "business insurance" for all of us in the years ahead.

The Independence Drive is being powerfully promoted throughout the nation by radio, television, publication advertising, posters, car cards, and special ceremonies. The public is *extra* Bond-conscious at this time. Make sure your company adequately informs your employees that the convenience of "automatic" Bond buying is available through your Payroll Savings Plan.

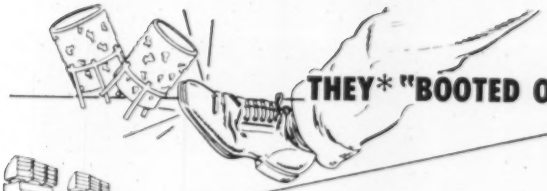
This is your country—so it's *your Drive*. Help to put it over. All the material and assistance you need are available from your State Director, Savings Bonds Division, U. S. Treasury Department. Go into action now!

The Treasury Department acknowledges with appreciation the publication of this message by

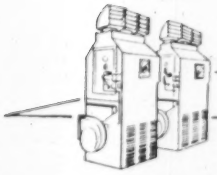
**HEATING, PIPING & AIR CONDITIONING**

BOOST BONDS FOR INDEPENDENCE • PROMOTE PAYROLL SAVINGS •

This is an official U. S. Treasury advertisement prepared under the auspices of the Treasury Department and The Advertising Council.



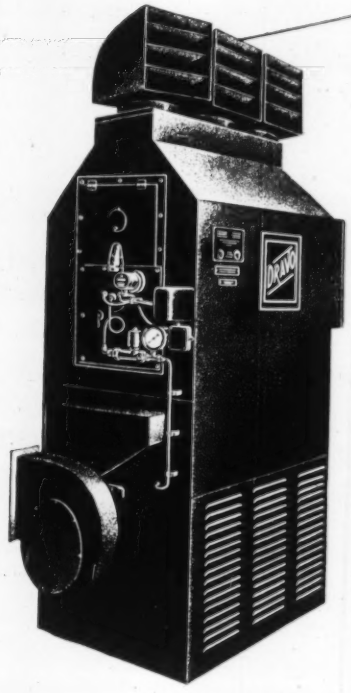
# THEY* "BOOTED OUT" SALAMANDERS



## THEY INSTALLED DRAVO HEATERS

## THEY *SAVED* $4,372.00 PER YEAR

*Rosedale Foundry and Machine Company, Pittsburgh, Pa.




Like many other metalworking plants, Rosedale, producers of Meehanite Metal castings, depended for years on salamanders for heating. Everyone *assumed* that any more modern method would cost too much, and probably couldn't heat the high-roofed, metal structure much better anyway.

But no one was happy about the situation. Coke and labor were big cost items. Production was lost while men "thawed out." Air was smoky and sulphurous.

So Rosedale investigated, and found (1) that Dravo *Counterflo* Heaters could do the job for LESS cost than salamanders, (2) that Dravo was already heating many similar structures with complete satisfaction, and (3) that Dravo Heaters would help clear up the polluted atmosphere.

Result: four Dravo *Counterflo* Heaters were installed, eliminating 39 salamanders. Yearly cost-reduction is $4372. Even with 25% annual amortization, this company is currently saving $500 a year. After four years the investment will be completely written off, and the entire saving will be velvet. The indirect savings—improved production, greater employee comfort, elimination of coke fumes, and saving in floor space—are extra dividends. Everybody's happy about the heating now.

No one can afford, today, to put up with old-fashioned, inadequate heating equipment—any more than to use old-fashioned production machines. Let us review your heating problems, and provide you with some specific examples of the savings Dravo *Counterflo* Heaters are making for others—and that they can make for you. Consult your classified telephone directory for the name of the local representative—or write us direct, ask for bulletin MR 523.

**DRAVO**
**CORPORATION**
**DRAVO BUILDING, PITTSBURGH 22, PA.**

Dravo also manufactures the *DRAVO CRANE CAB COOLER* for air conditioning hot-metal crane cabs.

**PITTSBURGH • CLEVELAND • PHILADELPHIA • DETROIT • NEW YORK • CHICAGO • ATLANTA • BOSTON**

Sales Representatives in Principal Cities. Mfd. and Sold in Canada by Marine Industries, Ltd., Sorel, Quebec

Export Associates: Lynch, Wilde & Co., Washington 9, D. C.

DRAVO

# LOOK TO THE LEADER—LOOK TO PEERLESS

# FOR THE VERSATILE PEERLESS CHAMPION PUMP

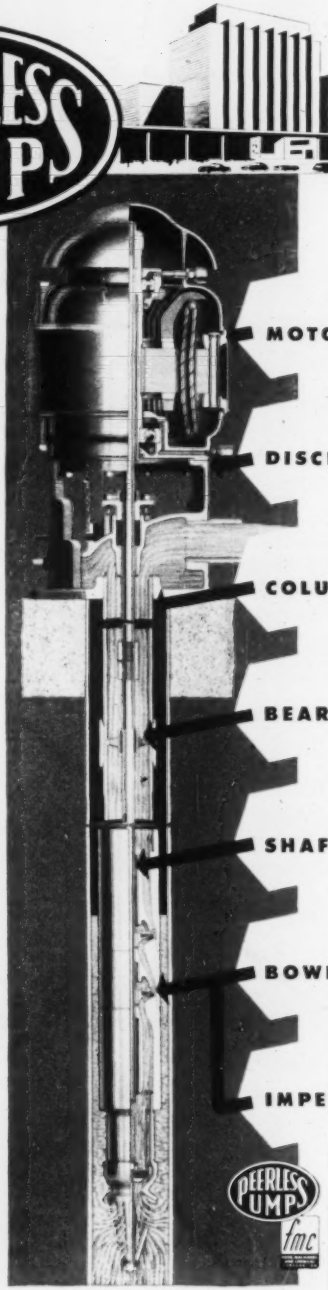
PEERLESS PUMPS

**ALL TYPES OF DRIVES**

CAPACITIES: Up to 5000 Gals. Per Hr.
LIFTS: Up to 200 Ft.
PRESSURES: Up to 90 Lbs.

**A PEERLESS CHAMPION PROVIDES PRESSURE WATER SUPPLY FOR:**

Commercial Buildings
Domestic Applications
Industrial Processes
Dairies
Bottling Works
Air Conditioning Applications



**FOR SMALL DIAMETER, MODERATE CAPACITY DEEP WELLS**

***Here is Turbine Pump Stamina, Quality and Reliability for Developing Water from Deep Wells***

Now, in the Peerless Champion, built by the makers of the world-famous Peerless deep well turbine pumps, you get the desirable features of Peerless deep well pumps, in a heavy-duty, top-quality, turbine pump, for small diameter deep wells. ***FOR EXAMPLE:***

**MOTOR...**
Vertical, hollowshaft electric drive head of standard make. Weather-proof.

**DISCHARGE CASTING...**
High grade cast iron with efficient and trouble-free packing gland.

**COLUMN...**
Full weight steel pipe. Accurately threaded and faced for permanent alignment.

**BEARINGS...**
Long, water-lubricated cutless rubber bearings —abrasion and sand resistant.

**SHAFTING...**
Precision ground, stainless steel, ends accurately threaded and faced.

**BOWLS...**
Porcelain enameled, scientifically designed to assure smooth water passage.

**IMPELLERS...**
High efficiency, semi-open type, high quality bronze insures extended life.

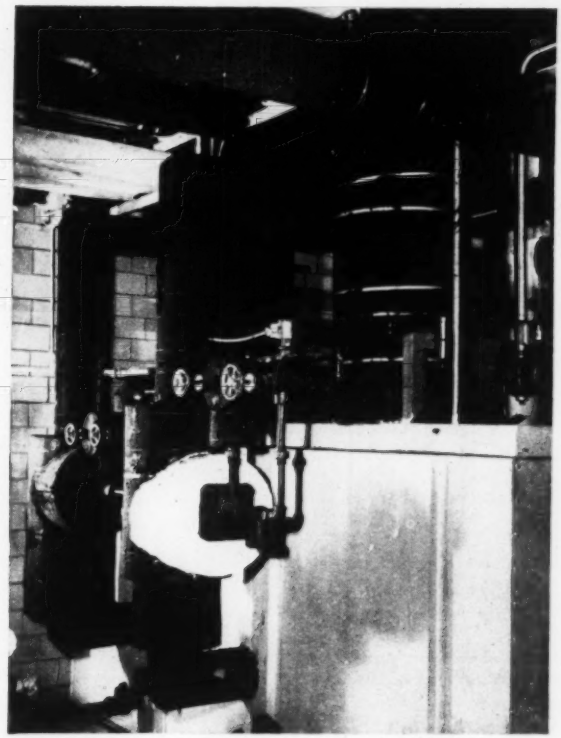
**Write today for Bulletin B-200-1**

**PEERLESS PUMP DIVISION**
**FOOD MACHINERY AND CHEMICAL CORPORATION**
Factories: Los Angeles, California, and Indianapolis, Indiana.
Offices: New York, Atlanta, Chicago, St. Louis, Phoenix, Fresno, Los Angeles, Dallas, Plainview and Lubbock, Texas, Albuquerque, N. M.

# For your buildings . . . For your equipment . . .

## the long life insulation

# PC FOAMGLAS



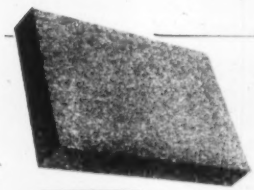
IN THE NEW antibiotic building of Parke, Davis & Company, Detroit, Michigan, PC Foamglas Pipe and Fitting Insulation has been used on the pipe lines. A finish will be applied over the insulation and painted to match the interior color scheme.

● In walls and floors, roofs and ceilings of all sorts of buildings, PC Foamglas helps to maintain predetermined temperature and humidity levels—retards heat travel into or out of the structures . . . minimizes condensation that is so damaging to masonry, precision machines and goods in process.

The same properties that have won Foamglas wide acceptance as building insulation make it the ideal material for insulating indoor and outdoor pipe lines, ducts, tanks, towers and other processing equipment operating within established temperature limits.

Because it is a true glass in cellular form, Foamglas is exceptionally effective insulation. Its physical structure gives Foamglas unusually high resistance to moisture, vapor, acid atmospheres and other destructive elements. The resultant freedom from repairs, maintenance and replacement makes Foamglas a truly economical insulation. When properly installed, Foamglas *retains* its original insulating efficiency.

When you are figuring on insulation, make sure you have the latest information on PC Foamglas. You will find it in our recently published booklets and folders, which contain descriptive text and photos of recent jobs, charts, tables, up-to-date specifications and installation instructions. Just send in the convenient coupon and you will receive promptly a sample of Foamglas and your selection of our literature.



### This is FOAMGLAS

The entire strong, rigid block is composed of millions of sealed glass bubbles. They form a continuous structure which has unusually high resistance to moisture, vapor and acid atmospheres, is noncombustible, vermin-proof and odorless. In those closed glass cells, which contain still air, lies the secret of the material's long life insulating efficiency.

Pittsburgh Corning Corporation
Dept. RR-50, 307 Fourth Avenue
Pittsburgh 22, Pa.

Without obligation on my part, please send me a sample of Foamglas and your FREE booklet on PC Foamglas Insulation for:

Piping & Equipment ☐ Refrigerated Structures ☐ Commercial, Industrial and Public Buildings ☐ Home Insulation ☐

Name.....

Address.....

City..... State.....

PITTSBURGH PC CORNING

## FOAMGLAS INSULATION

*. . . when you insulate with FOAMGLAS . . . the insulation lasts!*

# Another famous building Marsh equipped...

ARCHITECTS
Ellerbe & Co., St. Paul, Minn.
Leo A. Daly Co., Omaha, Neb.

MECHANICAL CONTRACTOR
B. Grundwald, Inc., Omaha, Neb.

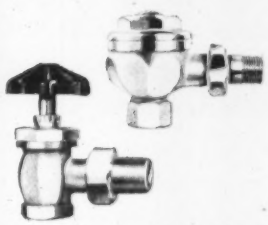
Here is the architectural rendering of a massive institutional building that will rank high on the list of America's truly great hospitals. It is the Veterans Administration Hospital at Omaha.

Every detail of this magnificent structure has been planned to contribute the utmost efficiency in the care of patients; and of course no factor entering into this is more important than heating comfort. It is therefore particularly significant that after the most searching analysis of heating requirements Marsh valves, traps and vents were chosen for the vital spots in the steam distribution system.

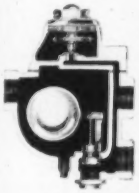
Practically all types of Marsh heating specialties are installed here. There are hundreds of Marsh packless radiator valves and radiator traps; a large number of Marsh float and thermostatic traps; many Marsh inverted bucket traps, strainers, and vents.

Yes, the selection of Marsh equipment for this modern hospital is a resounding tribute to the quality and dependability of Marsh heating equipment. But it is only one more example of the preference accorded Marsh equipment by foremost heating engineers and contractors.

For that next job insist on the equipment that is first choice where only the best is good enough!



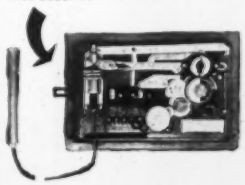
Hundreds of Marsh Specialties like this were used in the Veterans Administration Hospital — the finest of packless valves and the most efficient of radiator traps.



Float and thermostatic traps like this were used; also many inverted bucket traps, vents and strainers.

**BIG FUEL SAVINGS—when the heat is controlled by Marsh TRI-TROL.**

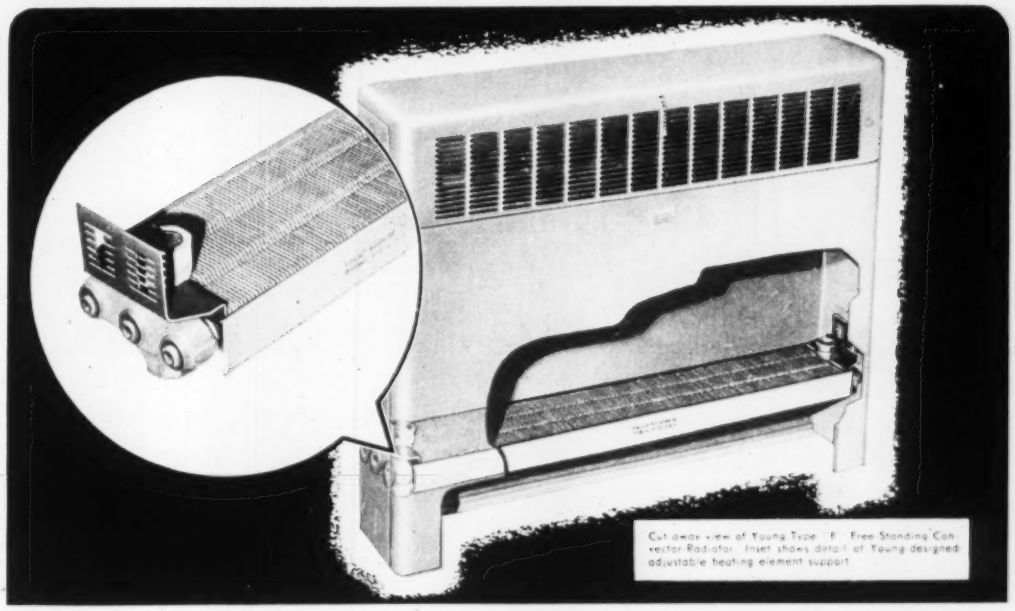
For multiple occupancy buildings of any size TRI-TROL is the simple, low-cost, easily installed regulator giving control "in step with the weather" which means ideal heating comfort at lowest cost. Ask about it.



**MARSH HEATING EQUIPMENT CO.**
Sales affiliate of Jas. P. Marsh Corp.
Dept. T., Skokie, Ill.

**MARSH** *Heating Specialties*
**SINCE 1865**

# Save on Installation Costs with **YOUNG** CONVECTOR-RADIATORS



Cut-away view of Young Type F Free Standing Convector Radiator. Inset shows detail of Young designed adjustable heating element support.

Once again Young Engineering saves you money. A new heating element support cuts installation time and permits quick pitching adjustments. Its rigidity permits shipping core in position ... another time saver. An additional Young innovation, unit packaging, also speeds handling on the job. Each sturdy carton is clearly marked for quick identification and protects units in handling. The Young Convector-Radiator Line includes a style and size for any hot water and two-pipe steam system. Mail the coupon below for further helpful information.

**YOUNG**

Heat Transfer Products for Automotive and Industrial Applications.

Young Quality

T. M. Reg. U. S. Pat. Off.

Heating, Cooling and Air Conditioning Products for Home and Industry.

**YOUNG RADIATOR COMPANY**

DEPT. 510-G RACINE, WISCONSIN

Plants at Racine, Wisconsin and Mattoon, Illinois
Sales and Engineering Offices in All Principal Cities

**LEARN HOW YOUNG CONVECTOR-RADIATORS CAN CUT CORNERS ON HEATING BUDGETS**

YOUNG RADIATOR COMPANY
Dept. 510-G
Racine, Wisconsin

Rush me full details about the Young Convector-Radiator Line, without obligation.

Name_____

Address_____

City_____ Zone____ State_____

# There's an EASIER WAY

**...To Open a Sardine Can**

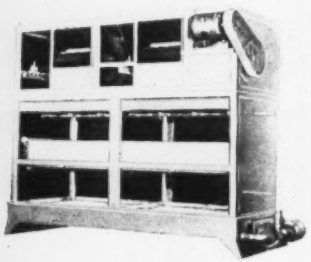
**...Or to "Get Into" Heat Transfer Air Units**

***Always Specify***

**KENNARD** *Engineered*

**EVAPORATIVE CONDENSERS**
**COOLING TOWERS**
**AIR CONDITIONING UNITS**

# *for ACCESSIBILITY*



Quality-built KENNARD units seldom require servicing. However, on the rare occasions when servicing is necessary, you'll appreciate Kennard's multiple service and access panels, permitting servicing from any or all of FIVE sides—all parts readily accessible.

In addition to convenience in servicing, ALL Kennard Engineered products have exclusive "built in" features to provide maximum service at minimum cost.

These are the reasons why so many architects and engineers specify "KENNARD"—the quality line with ALL of these advantages—Penta-Post frame construction, non-corrosive metal screws, nuts, bolts and washers; solid bronze latches, non-corrosive coil frames and hydraulically 3000 psi expanded scale free coils.

*"Refinement of Detail Marks the Difference Between Ordinary and Excellent."*

***Write for Bulletins...***

**No. 47A—FINNED COILS**
**No. 486—AIR CONDITIONING BLOWER UNITS**
**No. 491—EVAPORATIVE CONDENSERS**
**No. 494—COOLING TOWERS**

**KENNARD CORPORATION** • **1817 S. HANLEY ROAD ST. LOUIS 17, MISSOURI**

# IT'S A CRIME!

## TO THROW AWAY 30% OF THE PRICE OF AIR FILTERS!

# Glasfloss

## RE-FILL TYPE AIR FILTERS END THIS COSTLY WASTE

Thirty percent of the cost of most air filters is in the frames that are thrown away. Glasfloss now offers a glass fibre air filter in a light-weight metal reusable frame that saves 30% on replacement purchases.

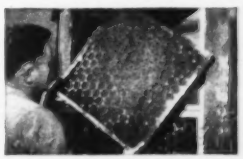
When the Glasfloss pad has accepted its full load of dirt, open the frame, discard the pad and insert a new one.

### EXTRA FINE FIBRES

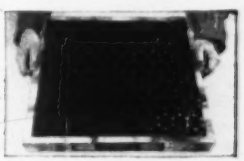
Glasfloss Air Filters are made of long, extra fine fibres that form a fluffy mass with millions of air passages. That's why they stop more dirt while permitting free movement of air. The silky fineness of Glasfloss fibres permits them to be handled without injury or discomfort.

### FIGURE IT OUT—

Any large filter installation, whether for Warm Air Heating, Ventilating or Air Conditioning, offers interesting savings when equipped with the Glasfloss Re-fill Type Air Filters. Each replacement costs 30% less than replacement with disposable filters. Write for full information. Dept. HP.



When Glasfloss pad is full, just remove it from the lightweight re-usable metal frame



Insert a new pad and replace—at a saving of 30% over disposable filters.

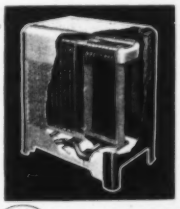
Glasfloss Air Filters — Re-fill Type — They STOP DIRT NOT AIR.

# Glasfloss

**155 E. 44th Street, New York 17, N. Y.**

THE NEW ROYALINE CIRCULATORS are designed for *three-way customer appeal* . . . they are outstanding in appearance, comfort and economy! Styled with smooth, flowing lines and finished in a beautiful duo-tone brown enamel, a Royaline Circulator will add charm to any surroundings. The famous Humphrey burner and ingenious method of rapid heat exchange and circulation assure clean, fast and sustained heat . . . the initial low cost and economical operation, plus years of satisfactory performance, will appeal to any customer.

Write today for catalog and prices on Humphrey Royaline circulating gas heaters.



***FEATURES THAT WILL MAKE ROYALINE YOUR PROFIT LINE!***

ROYALINE circulating heaters are sturdy all metal construction, built to last a lifetime, beautifully styled and finished in popular, easy to clean, rich duo-tone brown.

The heavy gauge steel heat exchanger effects a rapid transfer of heat to the air stream through the large top and front grille area, and at a minimum of fuel cost. The famous Humphrey Economy Burner can be controlled either automatically or manually . . . completely equipped with latest safety controls. Operate on all types of gases.

**GENERAL GAS LIGHT COMPANY**

HUMPHREY PRODUCTS

**KALAMAZOO MICHIGAN**

23 Warren Street, New York City • 2nd Unit Santa Fe Building, Dallas • 225 Eleventh Street, San Francisco

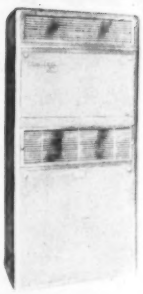
# A *Curtis* Franchise

## IS BECOMING MORE AND

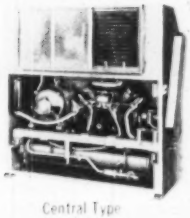
# MORE PROFITABLE

## BECAUSE OF NEW ADDITIONS TO THE LINE

## 2, 4, 6, 8-Ton Packaged Units
## 10 and 15-Ton Central Type Package Units
## Condensing Units – 1/4 H. P. Thru 40 H. P.

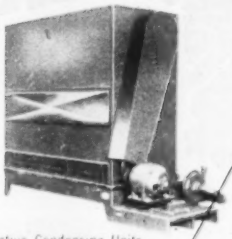


2, 4, 6, 8 Ton Packaged Air Conditioning Units

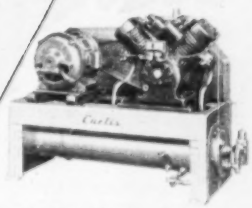


Central Type 10 and 15 Ton

*and*



Evaporative Condensing Units, Cooling Towers and Air Handling Units



Water Cooled Condensing Units 1/4 H.P. thru 40 H.P.

Distributors have long known of the unsurpassed quality and performance record of Curtis equipment. Now, because of the strong continued National Advertising Campaign, users of air conditioning are asking for Curtis. They know it as a quality product.

This broad line permits Curtis distributors to handle air-conditioning jobs profitably.

## *Powerful National* ADVERTISING

FULL PAGES IN

*Saturday Evening Post* *Time* *Newsweek*

and many other publications

Curtis REFRIGERATION AIR CONDITIONING COMMERCIAL

*96 Years of Successful Manufacturing*

**Curtis**

CURTIS REFRIGERATING MACHINE DIVISION
of Curtis Manufacturing Company

1950 Kienlen Ave. • St. Louis 20, Missouri

P50-6

## A Fine Pump Made Even Better.....

# The New Chicago

# CLOSE COUPLED PUMP

Completely redesigned, this sturdy, compact unit is now better than ever. 40 years' experience with pumps for every application is built into the newly designed Chicago Close Coupled Pump. A precision mechanical seal insures against leaking. No expensive piping needed from drip pocket to drain. No messy floors. No wasting of glycol type heat transfer agents. The Chicago Close Coupled Pump does the biggest job in the least space.

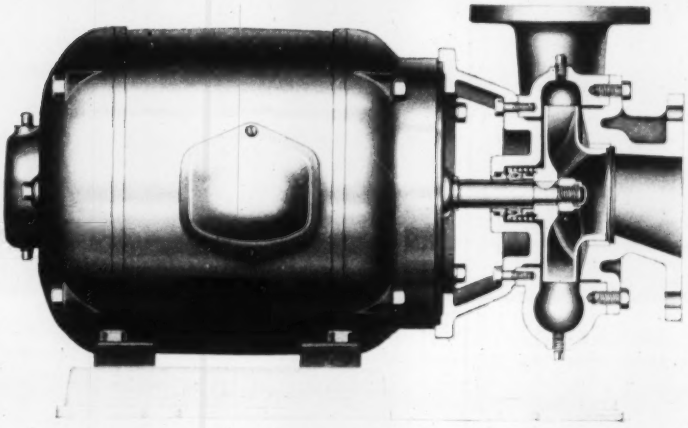


Fig. XN89. Cross section of Chicago Close Coupled Pump.

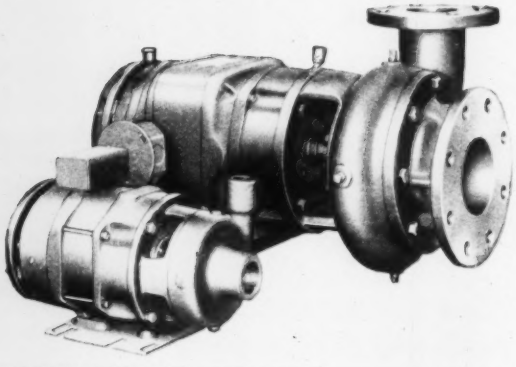


Fig. N8911-8. Two of the new line of Close Coupled Pumps, the 1" NM103 and the 3" NM3.

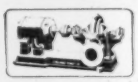
### MECHANICAL DESCRIPTION

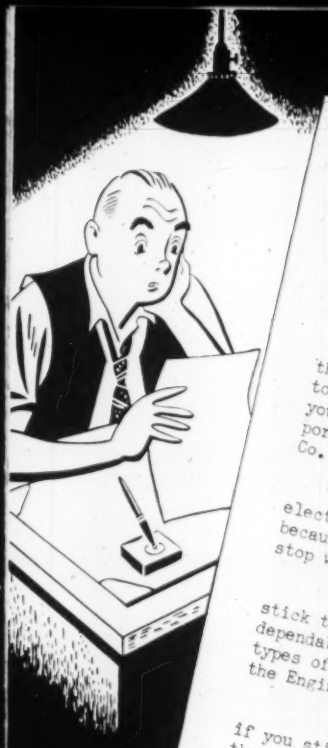
Bronze impeller is keyed to a stainless steel motor shaft and is secured with a special lock nut. A precision built mechanical seal on the shaft requires no adjustment and eliminates dripping. Discharge opening may face in any direction. Pipe discharge sizes: 1, 1¼, 2, and 3". For capacities up to 500 G.P.M. and heads up to 215'. Pump may be mounted either vertically or horizontally. Pumps up to 2" have screwed pipe connections. 3" pump has flanged pipe connections.

*For complete description and capacity tables, write for Bulletin 108.*

## CHICAGO PUMP COMPANY

**BUILDING and INDUSTRIAL DIVISION**

**2300 WOLFRAM STREET**  **CHICAGO 18, ILLINOIS**



Super Duper BURNER CO.

# FIELD ENGINEERING Memo

FROM: G.W.T.

TO: A.W.L

Dear Alvin:

In reply to your Field Report #786 we can only conclude that you did not receive the Engineering Bulletin which we mailed to you c/o General Delivery at Allentown last month. If you had, you would have known that the only answer to the trouble you reported due to flame rod failure on Amalgamated Twisted Pretzel Co.'s burner is the Fireye Flame Rod.

The sooner you realize that flame rods which act on the electrical rectification principle alone, are often undependable... because all gas flames are not rectifiers...the sooner you will stop wasting time on this needless trouble.

You can forget all about flame rod trouble if you'll stick to Fireye Flame Rods. Our field reports show that they give dependable, safe protection on all types of gas flames and all types of burners...as shown on the enclosed drawings taken from the Engineering Bulletin which you probably got, but didn't read.

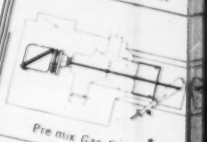
Even without the trouble you report, we'll feel safer if you stick to Fireye, because their special alloy rods outlast the stainless variety you reported, by 4 to 1.

If you really didn't get that engineering report, return the post card enclosed and we'll bring you up to date so you'll be able to forget flame rods and get some profitable work done.

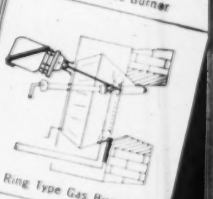
George
George

P. S. Thanks for sending that carton of pretzels. The boys washed them down with beer at the Friday P.M. bowling session.

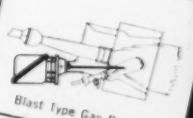
Oil Burner Pilot



Pre-mix Gas Burner



Ring Type Gas Burner



Blast Type Gas Burner

**Send the card which George enclosed to get *YOUR* copy of "SERVICE HINTS ON RODS" containing complete installation and servicing information.**

Combustion Control Corp.
79 Broadway, Cambridge 42, Mass.

George — Send me that copy of "Service Hints on Flame Rods"

Name _____

Company _____ Title _____

Street _____

City _____ Zone ____ State _____

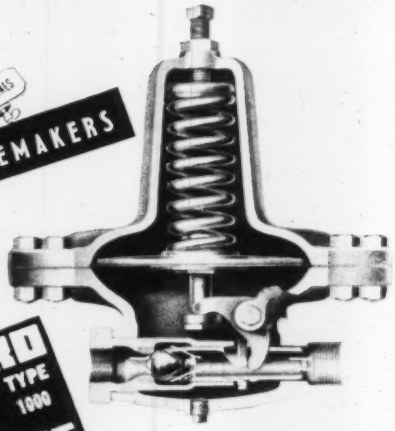
fireye

# COMBUSTION CONTROL CORP.

*Flame Failure Safeguard for Oil and Gas Burners*
*Photoelectric Smoke Indicators*

77 BROADWAY CAMBRIDGE 42 MASS

## GET RID OF THESE TROUBLEMAKERS



Many Businesses Do by Installing the . . .

# CASH STANDARD Streamlined TYPE 1000 PRESSURE REDUCING VALVE

## Check THE NUMBER BEFORE EACH OF THE FOLLOWING USER'S STATEMENTS AGAINST THE 10 POINTS LISTED

1. A manufacturer checks 6 of the points and says, "Installed the '1000' on our fuel burning equipment and HAS GIVEN ENTIRE SATISFACTION."

2. A chemical company checks 6 of the points and says, "We have operated two of your CASH STANDARD Streamlined Type '1000' Pressure Reducing Valves in our plant for eighteen months with NO MAINTENANCE OR ADJUSTMENT REQUIRED."

3. A lumber company checks 3 of the points and says, "We use this valve to REDUCE THE PRESSURE from our boilers to the office where we use this steam from the boilers to heat the office. We have USED THIS VALVE FIVE YEARS and it has NEVER GIVEN ANY TROUBLE."

4. A machine works checks 9 of the points and says, "We have had NO TROUBLE with the '1000' valves now in use on our preloading unit."

5. A laundry checks 7 of the points and says, "It is a GOOD TROUBLE-FREE, TIGHT CLOSING, COST-SAVING VALVE with PRACTICALLY NO MAINTENANCE."

6. A meter manufacturer checks 4 of the points and says, "Valve used in Research Dept. for VARIOUS TEST PRESSURES THAT MUST BE MAINTAINED regardless of upstream pressure changes."

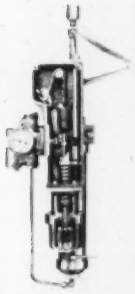
*Write For Bulletin 962*

7. A boiler and tank company checks 9 of the points and says, "We have in operation many CASH STANDARD Type '1000' Streamlined Valves and are pleased to state their PERFORMANCE HAS BEEN SATISFACTORY AT ALL TIMES."

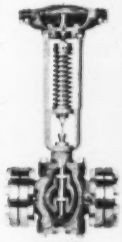
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 2 | | | 5 | | 7 | POINT No. 1<br>**Maximum capacity when needed most.** |
| 1 | 2 | | 4 | | 6 | 7 | POINT No. 2<br>**Accurate pressure control under toughest working conditions.** |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | POINT No. 3<br>**Trouble-free service.** |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | POINT No. 4<br>**Smooth operation.** |
| 1 | 2 | | 4 | 5 | | 7 | POINT No. 5<br>**Tight closure.** |
| | | | 4 | 5 | | | POINT No. 6<br>**Speedier production results.** |
| | | | 4 | 5 | | 7 | POINT No. 7<br>**Elimination of failures.** |
| | | | 4 | 5 | | 7 | POINT No. 8<br>**Cost-saving operation.** |
| | | | 4 | 5 | | 7 | POINT No. 9<br>**No spoilage.** |
| 1 | 2 | 3 | | | 6 | 7 | POINT No. 10<br>**Practically zero in maintenance.** |

**BULLETINS AVAILABLE ON OTHER CASH STANDARD VALVES**

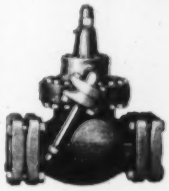
***Send for them***



Bulletin 963 features the CASH STANDARD Type 100 Series of Super-Sensitive Controllers — various types for automatically operating valves, dampers, rheostats, stokers, pulverizers, fans, and other apparatus. 16 pages filled with descriptions and applications.



Bulletin 968 features the CASH STANDARD Type 14 Pressure Reducing Valve — direct operated — direct acting for handling steam, hot water, cold water, air, oil, brine—and most liquids and gases except some injurious chemicals. Illustrates and describes the different styles available and tells about their applications. Three pages of capacity charts.



Bulletin 956 features the CASH STANDARD Type 4030 Back Pressure Valve — designed to automatically maintain a constant pressure in the evaporator corresponding to a constant temperature desired. Shows an Ammonia and Freon Gas Capacity Chart based on ABSOLUTE pressures.

CASH STANDARD CONTROLS.. VALVES

**A. W. CASH COMPANY**
**DECATUR, ILLINOIS**

# He's on your staff but not your payroll

It was a tough heating problem. Some contractors even ducked it. But one called on a proved source of engineering aid. And the Bryant distributor brought in the answer that landed the contract.

Yes, Bryant distributors welcome such opportunities. Complete and thorough factory engineering assistance is at their call. Thus, thinking of the industry's largest staff of gas heating engineers becomes a plus value for you.

Other plus factors of the Bryant program are the opportunity of getting most everything in gas heating equipment from a single source . . . a near-by distributor with adequate warehouse stock . . . products built of the best materials, engineered to stand up under the hard service they must meet in today's commercial and industrial installations.

Perhaps there's a current project with which the Bryant distributor can help you. Remember . . . he's *on your staff* but *not your payroll!*

Let the pup be furnace man ... and water boy, too!

**bryant**

**AUTOMATIC HEATING**

The most complete line of gas heating equipment in the nation

Bryant Heater, Dept. 155
1782 St. Clair, Cleveland, Ohio

( ) Send me the new booklet that tells the Bryant story. ( ) Have your distributor call on me.

Name

Company

Address

City State

# Draftless Comfort for diplomats too

**THE U. N. SECRETARIAT BUILDING USES NEW ANEMOSTAT SQUARE AIR DIFFUSERS**

In conference rooms, offices, corridors . . . in fact, throughout the United Nations Secretariat Building the new square Anemostat Type E Air Diffusers provide stimulating, draftless comfort.

These new square Anemostat Air Diffusers offer *for the first time* . . . uniform circular air diffusion from a square outlet plus effective aspiration. This aspiration effect, the drawing of room air *into* the diffuser and mixing this room air with supply air *within* the outlet, is *the* important reason why Anemostats do a completely satisfactory job of eliminating annoying drafts and stale air pockets, equalizing temperature and humidity throughout the entire conditioned area.

**ANEMOSTAT®**

**DRAFTLESS *Aspirating* AIR DIFFUSERS**

ANEMOSTAT CORPORATION OF AMERICA

*10 East 39th Street, New York 16, N. Y.*

REPRESENTATIVES IN PRINCIPAL CITIES

*"No Air Conditioning System Is Better Than Its Air Distribution"*

Anemostat Type E Air Diffusers fit without modification into the framework that holds standard size acoustic tile. At a "twist of the wrist," the inner assembly can be quickly removed for cleaning.

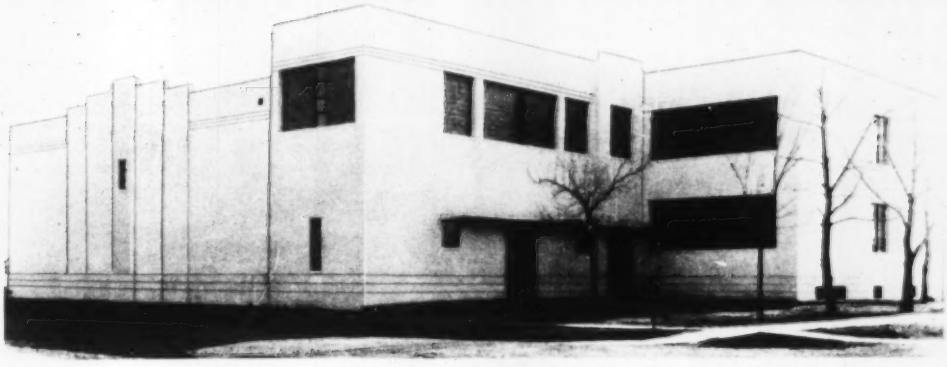
**SECRETARIAT BUILDING OF THE UNITED NATIONS**

Wallace K. Harrison, Director of Planning • Max Abramovitz, Deputy Director of Planning • James A. Dawson, Chief Constructing Engineer • Syska & Hennessy, Inc., Consulting Engineers • Fuller-Turner-Walsh-Slattery, Inc., General Contractor • Almirall & Co., Inc., Sub-contractors for Heating, Ventilating and Air Conditioning.

**BULLETIN 29A**

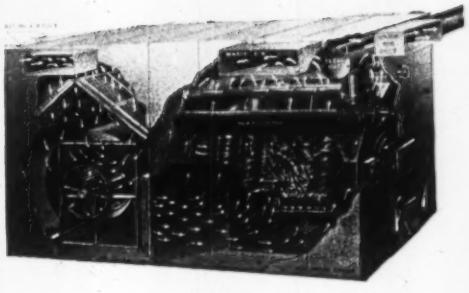
**Gives the complete story on the new Anemostat Types E and E-1 Air Diffusers. Write for your copy.**

# HEATED . . . with a single *STOKER-FIRED* CAMPBELL WARM AIR HEATER!



Public School, Ashley, N. D.; heated since 1936, with a single, stoker-fired Campbell unit.

Campbell 8000 Series Heaters are ideally suited for schools, churches and other large, multiple-room buildings. They are designed to deliver abundant heat, quickly, and with amazing fuel economy. They assure positive control of temperature, humidity and ventilation. Available for all fuels in capacities up to 2,160,000 B.T.U.s. We would be glad to submit specifications and quotations on any large warm-air heating job.



FOR DRYING & PROCESSING

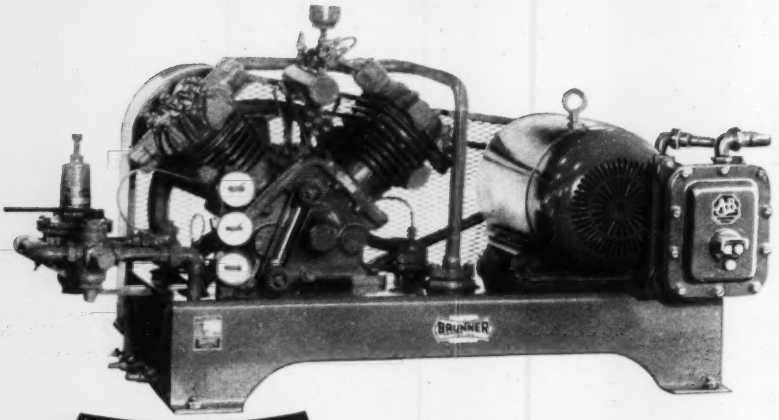
[illegible] we also build a unit oil and gas fired heater up to 14,000,000 B.T.U.'s.

*Campbell*

**HEATING COMPANY**

**3140 Dean Avenue, Des Moines 17, Iowa**

*Every Campbell Heater backed by 65 Years Heating Experience*



The Brunner LPG (Liquefied Petroleum Gas) Compressor Unit is equipped with an explosion-proof motor and an A-B Solenoid Starter in a NEMA Type 7 enclosure for hazardous gas locations.

# BRUNNER COMPRESSOR UNITS

*equipped with*

# A-B Quality Trouble Free Motor Controls

A-B Bulletin 709 Solenoid Motor Starter in NEMA 7 enclosure. Air break contacts. Gray enamel finish. White interior.

**WHY ARE ALLEN-BRADLEY STARTERS SO POPULAR** for air-conditioning service? . . . Because they are trouble free. Only one moving part. No pivots, pins, or bearings to corrode or stick . . . no jumpers to break. You install them . . . and forget them!

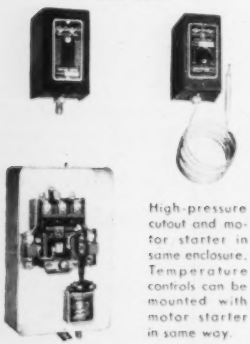
**NO CONTACT MAINTENANCE.** Allen-Bradley patented silver alloy contacts never need cleaning, filing, or dressing.

**DEPENDABLE OVERLOAD RELAYS.** Allen-Bradley thermal relays are accurate and dependable even after long service.

The A-B trademark stands for millions of trouble free operations. Allen-Bradley Co., 1335 S. First St., Milwaukee 4, Wisconsin.

## ALLEN-BRADLEY AIR-CONDITIONING AND REFRIGERATION CONTROLS

PRESSURE AND TEMPERATURE CONTROLS



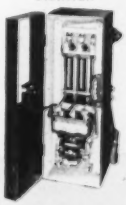
High-pressure cutout and motor starter in same enclosure. Temperature controls can be mounted with motor starter in same way.

MANUAL STARTER

AUTOMATIC STARTER

COMBINATION STARTER

HEAVY COMPRESSION STARTER

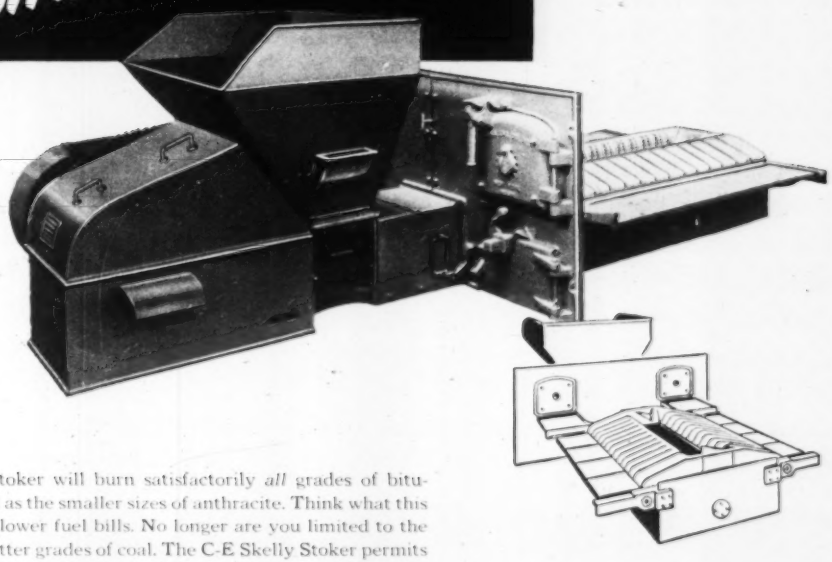


# ALLEN-BRADLEY

## SOLENOID MOTOR CONTROL

# Why not buy a stoker that will burn either...

## *Anthracite or Bituminous Coal?*



The C-E Skelly Stoker will burn satisfactorily *all* grades of bituminous coal as well as the smaller sizes of anthracite. Think what this means in terms of lower fuel bills. No longer are you limited to the more expensive, better grades of coal. The C-E Skelly Stoker permits the use of the most economical type of coal available in your locality. This flexibility in the choice of coals enables you to keep your heating costs at a minimum. In fact, it makes your purchase an investment rather than an expense.

For, since the cost of fuel burned on a stoker in a single year often greatly exceeds the initial cost of the stoker itself, it is evident that *what kind* of coal a stoker will burn and *how well* it will burn it is a far more important consideration than the purchase price.

Moreover, the C-E Skelly Stoker assures top performance with minimum maintenance. For this stoker reflects the practical knowledge of fuels and operating conditions that Combustion has acquired in installing over 20,000 stokers of *all* types above residence size.

You can turn to C-E with complete confidence that you are purchasing a stoker that you can rely on for years of dependable, economical service. Why not investigate the C-E Skelly Stoker for your next installation?

B-362

C-E

**COMBUSTION ENGINEERING-SUPERHEATER, Inc.**

A Merger of Combustion Engineering Company, Inc. and The Superheater Company

**200 Madison Avenue · New York 16, N. Y**

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS, ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS.

# Air Diffusers *Tailor-Made* To Your Specifications

***The Diffusing Vanes Make the Difference!***

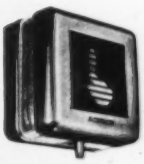
Here's the only air diffuser tailor-made to suit conditions of each application . . . the only air outlet with patented diffusing vanes which may be assembled in a variety of patterns to provide "blows" in one - two - three - and four directions. That's why Agitair assures 100% air distribution in any shape area, from any location, without makeshift blank-off's or oversized outlets. Discover the many exclusive Agitair advantages.

*Write For Complete Data*

**AIR DEVICES, Inc.** **17 East 42nd St. • New York 17, N. Y.**

Air Diffusers • Air Filters • Roof Exhausters

American Blower—a time-honored name in air handling



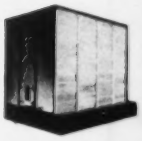
Venturafin Unit Heaters

Mechanical Draft Fans

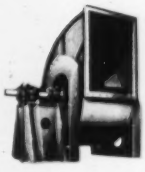
Utility Sets

Ventura Ventilating Fans

Dust Collectors



Air Washers



Industrial Fans

Heating and Cooling Coils

Air Conditioning Equipment

**In Dallas,** as in other cities, American Blower Air Handling Products serve commerce, industry and public utilities. For air handling data in the Dallas area, call American Blower—Central 5518. In other areas, consult your phone book.

**There's a** big difference in quality, design, quietness, operating costs and efficiency between American Blower and ordinary air handling equipment. Compare! Look before you buy—and you'll buy American Blower products every time.

# Air is free . . . use it profitably!

WHETHER you want a single ventilating fan for a home or complete air handling equipment for a factory, here are 5 points to guide you:

(1) Is the proposed equipment built by a reputable manufacturer with a background of years of experience?

(2) Has the manufacturer facilities for research and testing?

(3) Are units tested in accordance with the Standard Test Code? Are ratings CERTIFIED?

(4) Are the services of experienced engineers available at conveniently located branch offices?

(5) Will the manufacturer (when it's practical) furnish equipment to run comparative tests?

If you consider the merits of the air handling equipment you are about to buy in the light of these points, we're certain you'll agree that American Blower offers more value per dollar invested.

Our nearest branch office will give you full data.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary Corporation

YOUR BEST BUY

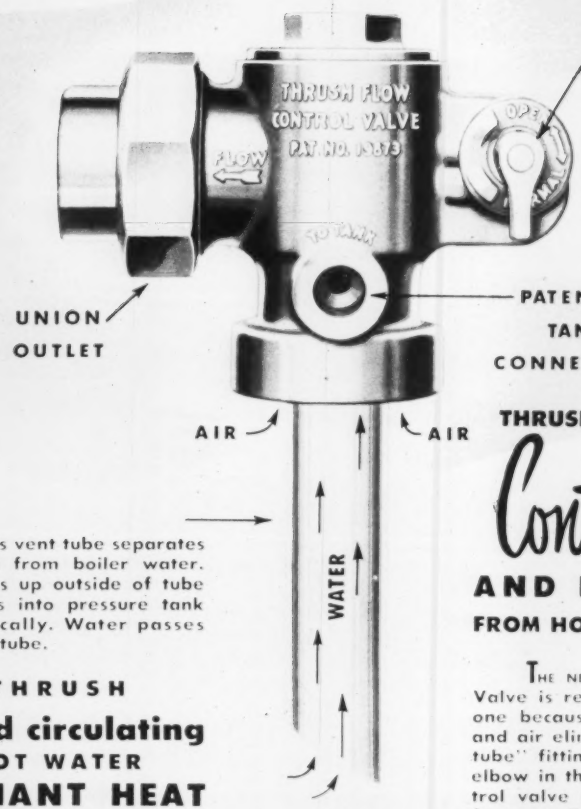
**AMERICAN BLOWER**

AIR HANDLING EQUIPMENT

*Serving home and industry*

AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TON-WANDA IRON

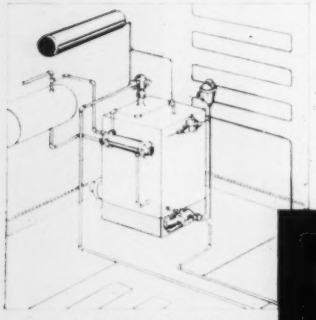
# Two Valves In One!




Brass vent tube separates air rising from boiler water. Air passes up outside of tube and vents into pressure tank automatically. Water passes up inside tube.

**THRUSH**

**forced circulating**
**HOT WATER**
**RADIANT HEAT**



COMPLETE CONTROL FOR AUTOMATIC HOT WATER HEAT

**THRUSH FLOW CONTROL VALVE**

## Controls Flow

**AND ELIMINATES AIR**
**FROM HOT WATER HEATING SYSTEM**

THE NEW IMPROVED Thrush Flow Control Valve is really two valves for the price of one because it provides both flow control and air elimination without any extra "air-tube" fitting. It also takes the place of an elbow in the flow riser. No other flow control valve has all these outstanding value features. Get the facts now.

Highest boiler temperature occurs when the Flow Control Valve is closed. Air and gases which are liberated as the water is heated, vent directly into the pressure tank. Water which passes into the flow main, is always free of air. Result—greater heating efficiency—more uniform heat. You save material cost, save installation time, and reduce inventory requirements by specifying Thrush "T" Flow Control Valves. (They are also available without tube.) Ask your wholesaler for more information today or write Dept. **E-7.**

**H. A. THRUSH AND COMPANY**
**PERU, INDIANA**
*MANUFACTURER OF HOT WATER HEATING EQUIPMENT FOR MORE THAN A QUARTER CENTURY*

YOU CAN READ THIS IN *3 Minutes!*

# HOW TO MAKE MONEY SELLING RP FILTERS

There's money **to be made** selling R-P filters!

But . . . like everything else, filter sales are the result of effort, a fine product, good service and customer satisfaction.

We believe we have the necessary tools to help dealers increase profits and to make these profits while performing a distinct service to filter users.

Here is the story:

★ Among heating men, it's an accepted fact that dirty filters are a major cause for the failure of a forced warm air furnace to provide sufficient heat. But . . . most home owners do not realize this fact. Many forget to inspect or change filters . . . some are not even aware that they have filters in their furnace.

★ Here's how R-P helps in this situation. We will furnish, free of charge to the dealer, a system of **Service Record Cards.** Kept up-to-date and on file, these cards will indicate when a customer needs a filter change, and the number and size of filters required. There are several reminder mailings and envelope stuffers available to dealers too. These mailings, in advance of the heating season, will spread your business over a longer period reducing the usual last minute rush. Many customers will stop in and pick up the filters they need. From information on the cards, the correct filter can be carried on the truck when making a service call . . . you save profit normally lost through expensive call-backs.

★ Another R-P sales tool . . . for dealers who wish to install a complete service business is **Comfort Insurance Policies,** available at Research Products for the cost of the dealer's name imprint. In this set-up, service is sold in advance, the customer can forget about his filter problem, and the dealer's materials and manpower schedule can be maintained on a systematic basis . . . costly call-backs are again reduced.

★ Then . . . for maximum profits, the R-P **"Save The Frame"** system increases the margin even more. Simply save up a supply of the wire frames from R-P Self Seal Filters . . . dirty pads can be replaced with new . . . a $1.50 replacement for 50c. And . . . there's another advantage to this method . . . standard sizes can easily be cut down to meet special size requirements . . . again reducing call-backs.

★ Grease filters, washable air filters, filter banks and other related items round out a complete profit package.

Research Products Corporation maintains many other resources and helps to aid dealers in stimulating sales. For a more complete story, and a visual presentation, we suggest you fill in and mail us the coupon below.

*Mail Coupon!*

**Research Products Corporation**
**Dept. H**
**Madison 10, Wisconsin**

Please have your representative call to explain how we can increase filter sales with Research Products Dealer Aids.

Name .....

Firm .....

Address .....

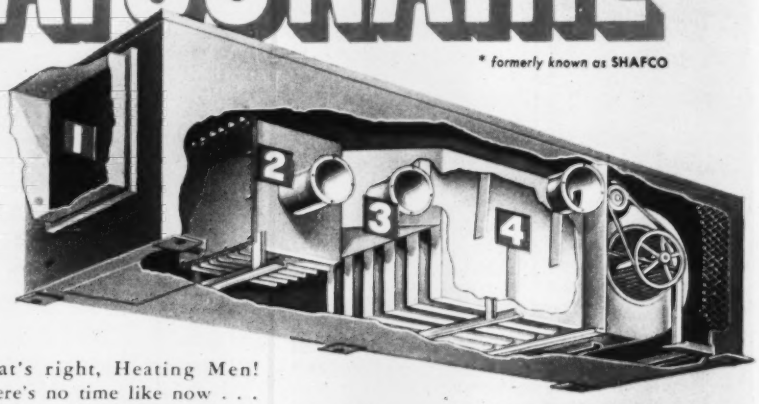
RP . . . PRODUCTS OF RESEARCH

WASHABLE AND REPLACEMENT AIR FILTERS • GREASE FILTERS • EVAPORATIVE COOLER MATERIALS

## NOW'S THE TIME TO "TIE IN" WITH

# SHAFCONAIRE*

* formerly known as SHAFCO




## Leader in the Overhead Oil-Fired Heating Market

That's right, Heating Men! There's no time like now . . . *right now* to get set with SHAFCONAIRE OverHead Heaters. They're big business boosters, extra profit producers. For SHAFCONAIRE, you know, is the original suspended oil-fired furnace known for years as SHAFCO. It's quality-built from end to end . . . designed especially for use in commercial and industrial buildings. Not just a domestic floor-type unit tilted horizontally on its side. And SHAFCONAIRE has been time-tested, thoroughly proved in use . . . the only furnace of its type backed by over 12 years actual operation in the field.

*MODELS from 100,000 to 405,000 B.T.U. for single or multiple unit installation to meet a wide range of commercial and industrial heating requirements.*

**OVERHEAD HEATERS, INC.**

*(formerly SHAFCO Distributing Corporation)*

1354 BOOK BUILDING • DETROIT 26, MICHIGAN

*And here's something to talk about*

## 4 ESSENTIAL FEATURES FOUND ONLY IN SHAFCONAIRE

**1. BUILT-IN PLENUM CHAMBER**—An exclusive patented feature that saves you plenty of time, trouble, and guess-work in making installations. Assures uniformly heated warm air output, eliminates on-the-job sizing and extra sheet metal work. Just top off ducts from end, top or both sides to meet installation requirements.

**2. HEAVY DUTY CONSTRUCTION**—Use of heavy gauge welded boiler plate assures long-life, trouble-free operation. No warping, no buckling, no burn-outs common to stamped steel construction.

**3. INTERMEDIATE HEAT-TRAVEL SECTION**—Patented intermediate chamber between refractory-lined firebox and heavy gauge heat exchangers serves to spread flame and eliminate impingement on metal. Permits expansion of hot gases, improves operating efficiency.

**4. EFFICIENCY ENGINEERED HEAT EXCHANGER**—Alternately spaced baffle plates in each of the heat exchanger sections effectively retard the flow of hot gases toward stack connection, permit maximum transfer of heat.

**OVERHEAD HEATERS, INC.**
1354 BOOK BUILDING • DETROIT 26, MICHIGAN

Please send me complete information and Price Lists on SHAFCONAIRE (formerly SHAFCO) OverHead Heaters.

*Name*_____

*Company*_____

*Address*_____

*City*_____ *Zone*_____ *State*_____

DON'T DELAY!
SEND COUPON TODAY!

You'll get complete details and price information on the "hottest" bet for extra profits in the present heating market.

# Figure it at

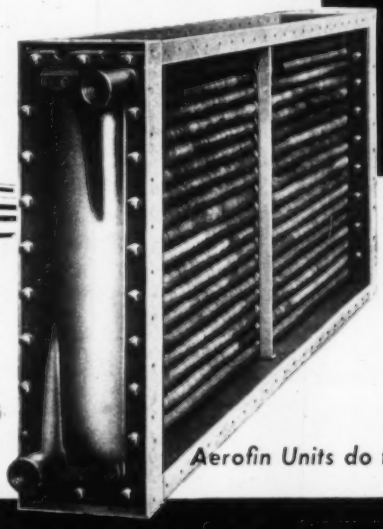
# FULL RATING

## AEROFIN RATINGS ARE ACCURATE AND RELIABLE

Aerofin's continued research has developed accurate ratings that are good for the life of the unit. You can always count on Aerofin to deliver full-rated capacity — full efficiency.

Over 25 years' experience, combined with unequalled production facilities, enables Aerofin to select just the right surface and materials for each particular job. Aerofin rigidly controls every phase of the production of its heat-transfer coils and units.

This man is looking for air bubbles —he is testing Aerofin heat-transfer coils with air pressure in a specially illuminated tank. If there are no bubbles, it means the immersed Aerofin unit has withstood the severe strains of steam and hydrostatic pressure tests and is ready to give you long, efficient service.



*Throughout the* **AIR CONDITIONING** *Industry —*

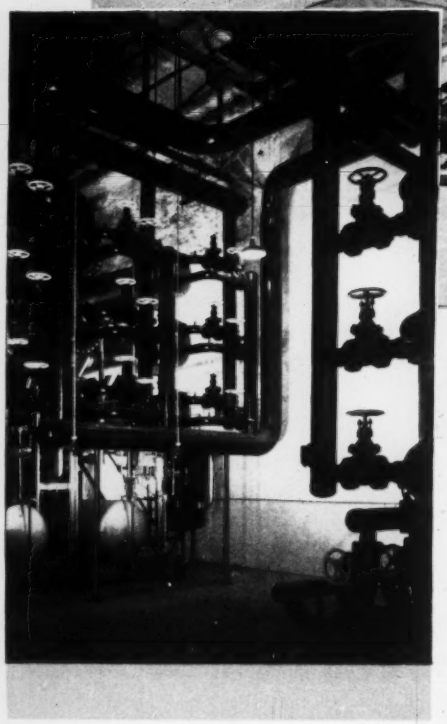
***Aerofin Units do the Job Better, Faster, Cheaper***

**AEROFIN CORPORATION**

410 South Geddes St. SYRACUSE 1, N. Y.

NEW YORK • CHICAGO • CLEVELAND • DETROIT • PHILADELPHIA • DALLAS • MONTREAL

# In the World's Biggest Refrigerator
# JENKINS VALVES stand guard
# against operating failure



More than 1000 Jenkins Valves are used for control of steam, water, brine, in piping systems for refrigeration, heating, fire protection, sanitation and other essential services.

THE 22-acre Alford Refrigerated Warehouse in Dallas, Texas, is "the biggest refrigerated area this side of the polar ice cap." With millions of dollars worth of perishable goods entrusted to constant cold, valves, like all other mechanical equipment, must perform with unfaltering efficiency.

For this reason, and with the further objective of low maintenance costs, the Alford management standardized on Jenkins Valves. More than a thousand are used along the miles of vital pipelines.

Jenkins builds extra endurance into valves—proved time and again by low upkeep cost records in every type of service. Yet, *you pay no more* for Jenkins Valves, despite this extra value. Let the Jenkins Diamond be your guide to valve economy . . . for new installations, for all replacements. *Sold through leading Industrial Distributors everywhere.* Jenkins Bros., 100 Park Ave., New York 17; Jenkins Bros. Ltd., Montreal.

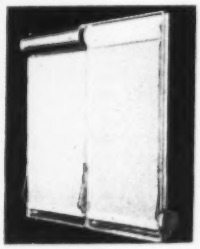
JENKINS
LOOK FOR THE DIAMOND MARK
VALVES

# EQUIPMENT DEVELOPMENTS...

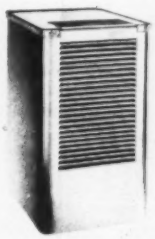
*For your convenience in obtaining more information about any of this equipment, see coupon on this page. Add the new products and companies listed here to your Directory Section which you received in your January 1950 Heating, Piping & Air Conditioning and thus keep your records of sources of supply up to date throughout the year. Single asterisk indicates equipment not listed in Directory Section; double asterisk, equipment and manufacturer not listed.*

**HPAC 1—DRY TYPE AIR FILTER**—According to American Air Filter Co., Louisville 8, Ky., the "Auto-Airmat" is the first automatic dry type air filter ever developed. It has been designed primarily for cleaning air having a high lint content and for providing an easy means of disposing of the collected material. It is especially recommended for use in the textile field, though there are said to be other numerous applications requiring the removal of fibrous or flaky dust.

A single ply of filtering paper from a roll at the top of the casing travels down the face of the filter on a rotating screen and is automatically rerolled at the bottom of the casing. The movement of the supporting screen is controlled by a pressure switch. When lint and dust deposited on the paper causes the resistance to air flow to rise to a predetermined point, the pressure switch closes a circuit to the drive motor which rotates the screen until a sufficient amount of clean paper is introduced to reduce the resistance 0.2 in. of water. The maximum resistance setting may be adjusted for any operating conditions. Dust and lint removed from the air are rolled up in the paper for disposal when the roll is discarded.



Air Filter



Dehumidifier

**HPAC 2—SMALL DEHUMIDIFYING UNIT**—A low cost $\frac{1}{8}$ hp dehumidifying unit for small establishments is being produced by Carrier Corp., Syracuse, N. Y., as a companion to its current $\frac{1}{3}$ hp "Humidry" which has found a variety of uses in preventing mildew, rot and rust resulting from high humidity.

Like the larger unit, the new dehumidifier is a compact, semi-portable machine that operates on a refrigeration principle. Under room conditions of 80 deg and 70 percent relative humidity, it is said to be capable of removing .18 pints of water from the air every 24 hr.

Warm, humid air is drawn by a fan over the chilled surface of the solder-dipped copper evaporator coil, and moisture from the air is condensed and collected on the coil and drained away. The cool air then passes over the warm condenser surface by forced circulation from the pressed steel fan and is recirculated around the room. The compressor is hermetically sealed.

**HPAC 3—ATOMIZING NOZZLE**—Spraying Systems Co., 3219 Randolph St., Bellwood, Ill., is offering the $\frac{1}{4}$ JAU automatic, pneumatic atomizing nozzle to provide an intermittent spray which is controlled by a cam or lever operated valve in the air line. The nozzle operates only when the air line is open. By either manual or mechanical operation of the air valve, the operating period of the nozzle can be timed to meet various requirements.

Nozzles are available in a variety of materials such as brass, stainless steel, and monel metal. They are supplied in a selection of air and fluid nozzle set-ups to produce a round spray, multiple round spray, or flat spray—for siphon type or pressure type operation. They are designed for all types of liquids and for use with compressed air, as well as many different types of gases.

**HPAC 4**—ELECTRONIC OIL BURNER CONTROL**—An electronic sequence and safety control system for industrial oil burners is being produced by Minneapolis-Honeywell Regulator Co., 2604 4th Ave., S. Minneapolis 8.

The controls turn on the pump and fan motors and simultaneously open a solenoid valve permitting gas to flow to the pilot igniter. An electric ignition lights the gas pilot flame. If the flame rod detects flame, it prepares the circuit to open the oil valve to the burner. If there is no flame, the rod will not permit the main oil valve to open. If the pilot light is operating satisfactorily, the amplifier of the control system opens the oil valve 15 sec

**FOR YOUR CONVENIENCE** [7-50]

**Heating, Piping & Air Conditioning**
**6 N. Michigan Ave., Chicago 2, Ill.**

**Please ask the manufacturers to send me more information about the equipment mentioned under the following reference numbers in Equipment Developments and Recent Trade Literature**

***(Circle each HPAC number in which you are interested)***

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
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| 131 | 132 | 133 | 134 | 135 | 136 | 137 | 138 | | |

Name ..... Title .....

Company .....

Address .....

City ..... Zone .... State .....

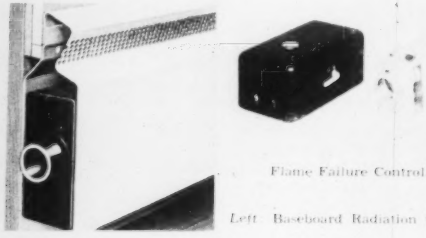
after getting the proper signal. The time delay permits the burner motor to come up to speed and deliver oil and air under the pressures required for operation.

The controls then permit oil to flow during the trial for main burner ignition period, which is adjustable from 5 to 180 sec. If the burner fails to ignite during the trial period, it is shut down. But if the main burner starts, a photoelectric cell "sees" the main flame and at the end of the trial run shuts down the circuit to the flame rod and the pilot flame. The main burner will then be operating under control of the photo cell. If the flame fails during operation, the photo cell will close down the burner immediately.

**HPAC 5—BASEBOARD HEATING UNIT COVER**—The new type L front cover for the baseboard "Radivector" of Vulcan Radiator Co., Hartford 6, Conn., features simplicity and attractive appearance.

The acute angle of the new multiple perforation (round) outlet is designed to screen the fin-tube core but not to interrupt the flow of convected heat which is combined with radiant heat from the solid front of the unit.

The new cover is interchangeable with covers on existing installations, is made of 18 ga cold rolled steel, and is furnished in any desired length (in increments of 1 in.) up to 8 ft.



Flame Failure Control

Left—Baseboard Radiation Cover

**HPAC 6—FLAME FAILURE SAFEGUARD**—"Fireye" safeguard system FF-3 of Combustion Control Corp., 77 Broadway, Cambridge 42, Mass., has been developed to provide flame failure protection for manually ignited and semi-automatic industrial oil burners. When flame fails, the fuel is cut off and the system may be used to sound an alarm.

The system consists of a scanner, type 45PH5, and a control, type 24QJ5. Housed in a dust-tight aluminum case, the scanner contains the electronic system, including the phototube and amplifier. The control contains the power supply and relay system. It is mounted on the control panel and contains a safety start circuit to prevent the burner from cycling if flame is detected or simulated prior to ignition.

**HPAC 7—VERTICAL CENTRIFUGAL PUMP**—Designed for use where net positive suction head is limited or where installation space is limited, the new encased, close-coupled vertical centrifugal "Hydro-Line" pump is available from Peerless Pump Div., Food Machinery and Chemical Corp., Los Angeles 31.

Consisting essentially of a vertical, close-coupled rotative shaft turbine pump, enclosed in a steel jacket or barrel, the pumping unit is ordinarily furnished complete with motor, motor-pump couplings, discharge casting with suction and discharge flanges, and multi-stage pump enclosed in the steel jacket. All types of drives are available and standard materials of construction include cast iron bowls, bronze impellers and 416 stainless steel shafting. Special materials are furnished when required by extraordinary conditions of service. Capacities range up to 5000 gpm and the maximum head is 1500 ft. Applications include the pumping of gasoline, oil, hot or cold water, acids, bases, and mild or concentrated salt solutions at temperatures from normal to 400 F.

**HPAC 8—COMBINATION HOT WATER AIR VALVE AND AIR CHAMBER**—The new "Chamber-Vent" of Dole Valve Co., 1933 Carroll Ave., Chicago 12, is a combination automatic hot water air valve and air chamber.

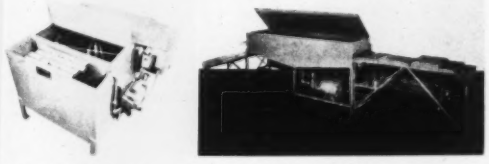
It is particularly designed for venting convectors, baseboard radiators, etc. on hot water heating systems. According to the manufacturer, the unit has four functions, as desired: an air chamber; an automatic air eliminator; a manual type air valve; and a manual shutoff. The valve is said to be easily adjusted, using a coin or screw driver, and is availaable from $\frac{1}{8}$ in. to $\frac{3}{4}$ in. size.

**HPAC 9—RUBBER PINCH VALVE**—A new rubber pinch valve for use in the mining, paper, chemical, oil, food and beverage industries has been developed by the mechanical goods division of United States Rubber Co., 1230 Sixth Ave., New York 20.

Advantages are said to include resistance to abrasive or corrosive action, flexibility which will offset misalignment in pipes, the fact that packing or repacking is not required, and absorption of vibration. Its metal parts can be refitted to new valve bodies, thereby reducing replacement costs, and it will break up galvanic action in metal lines.

Valves are available in abrasive and corrosive resistant compounds; neoprene for oil resistance, butyl rubber for high heat and severe acid conditions, and pure gum stock for food and beverage conveyance.

**HPAC 10—AIR FILTER WASHER, OILER**—A new utility washing and oiling machine for servicing viscous, impingement, panel type air filters has been developed by Farr Co., Los Angeles 43. The new washer and oiler is a modified version of previous models.



According to the company, the use of the washer and oiler reduces air filter maintenance costs as much as 67 percent, substantially increases filter life, assures positive oiling, and permits lower inventory stock. The unit, which can be operated by one man because all controls are automatic, accommodates filters up to 20 in. × 28 in. × 4 in. in size. In the illustration, the oiler unit is shown at the left, the washer unit at the right.

# INFRA-RED HEAT RAYS PIERCE 331 MILES OF DUST & FOG

"*With infra-red sensitized plates, views of mountains as far as 331 miles distant from the photographer have been taken, though the mountain itself was invisible to the eye because of intervening haze and fog.*". From Transactions of the 45th Annual Meeting, Amer. Society of Heating & Ventilating Engineers," by C. S. Taylor and J. D. Edwards, of the Aluminum Co. of America Research Laboratories.

"*A mirror, consisting of glass with a silvered surface on the back of the glass, is an excellent reflector of light but it is a very poor reflector of infra-red radiation corresponding to room temperature. In fact, such a mirror would have about the same reflectivity for infra-red as a heavy coating of black paint.*" state Profs. G. B. Wilkes, of Mass. Institute of Technology and E. R. Queer and F. G. Hechler of Eng. Experiment Station, Penn. State College, in "Thermal Test Co-efficients of Aluminum Insulation for Buildings."*

"*The visible brightness of a surface is not a gauge of its emissivity, for a surface may appear to have lost its reflective value and yet have a comparatively low emissivity as tested by a radiometer or emissivity-testing instrument,*" writes P. D. Close, as Technical Secretary of the Insulation Board Institute, in his book, "Building Insulation."

Of all heat flowing through building wall air spaces, 65% to 80% is radiation. Multiple sheets of accordion aluminum reflect, even if covered with dust, 97% of the infra-red heat rays. Compartmented with cellular air-spaces, they efficiently retard heat flow by convection and conduction. The commercial form of multiple sheets of accordion aluminum, permanently compartmented with cellular, reflective spaces, is Type 4 and Type 6 Infra Insulation, which cost respectively, under 7½c and 9c sq. ft., material with labor, between wood joists in new construction.

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| **Down-Heat** | **C.044, R22.75 equals 7½"** | **DRY Rockwool** |
| **Up-Heat** | **C.080, R12.50 equals 4"** | **DRY Rockwool** |
| **Wall-Heat** | **C.073, R13.69 equals 4½"** | **DRY Rockwool** |

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## BOLT THREADING

### *Announcing Handy New* RIDGID *Bolt Dies*

*No. OOR-B—¼" to 1" National Coarse and Fine Thread.*

● You're ready to thread bolts fast with these new RIDGID Bolt Dies. Dies easily reversed for threading close to bolt head. No adjustment needed for standard threads—adjust easily for undersize and oversize threads. Special steel dies, precision cut for long service. If you have a RIDGID OOR, buy bolt die heads alone, they fit OOR drive ring . . . an extra economy. Buy this new RIDGID at your Supply House.

*New* RIDGID *3-Way Bolt Die No. 33-B—Handy tool for ⅜", ½", ⅝".*

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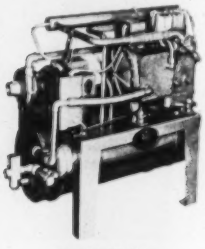
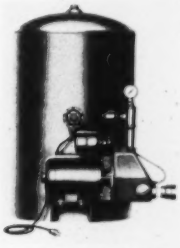
WORK-SAVER PIPE TOOLS
THE RIDGE TOOL CO. • ELYRIA, OHIO


**HPAC 11—LIQUID CHILLER**—The new "Flow-Cold" liquid chiller of Acme Industries, Inc., Jackson, Mich., is now available for air conditioning, for process water chilling, and for application to a heat pump cycle for "between season" heating or for full season heat pump operation where suitable heat sources exist.

Offered in six models ranging from 2 to 15 hp, the unit is completely assembled and ready for liquid and electrical connections. The compressor is of the sealed, hermetic type and direct expansion shell and tube chillers are standard on all models. A remote cooling coil is also available for air duct installation.



Liquid Chiller



Water Pumping System

**HPAC 12—WATER PUMPING SYSTEM**—A recent addition to the line of shallow and deep well water systems of Fairbanks, Morse & Co., 600 S. Michigan Ave., Chicago 5, is a new type of horizontal ejector pump which is automatically self priming with water at 25 ft.

Designed to give maximum capacity at a depth setting of 20 ft, for which the unit is especially recommended, the pump requires no special adjustments to put in service. It has but one moving part and requires no lubrication. The impeller and the built-in jet nozzle and venturi are made of bronze. A self aligning rotary seal on the motor shaft is designed to prevent water escaping from the pump volute and to eliminate the need of any packing glands.

**HPAC 13—COOLING SAFEGUARD**—A new control device which responds to a flow of cold water to open or close an electrical contact has been developed by the control division of General Electric Co., Schenectady 5, N. Y.

Called a flow interlock, the device closes a contact when a flow of water exceeds a preset amount and opens it when the flow falls below the preset amount. Working under this principle, it is said to act as a fuse in a circuit which depends upon water cooling for protection. According to the company, the interlock can be used as a safety device in many other applications where it is desirable to actuate an electrical contact with a flow of water.

Adjustment can be made to control the circuit for any flow from 1 to 4 gpm. The flow differential between the cut-in and the cut-out of the electrical contact is 0.2 gal minimum and 0.4 gal maximum. The unit does not control the amount of water flow, but this can be accomplished by installing a throttling or regulating valve ahead of the device.

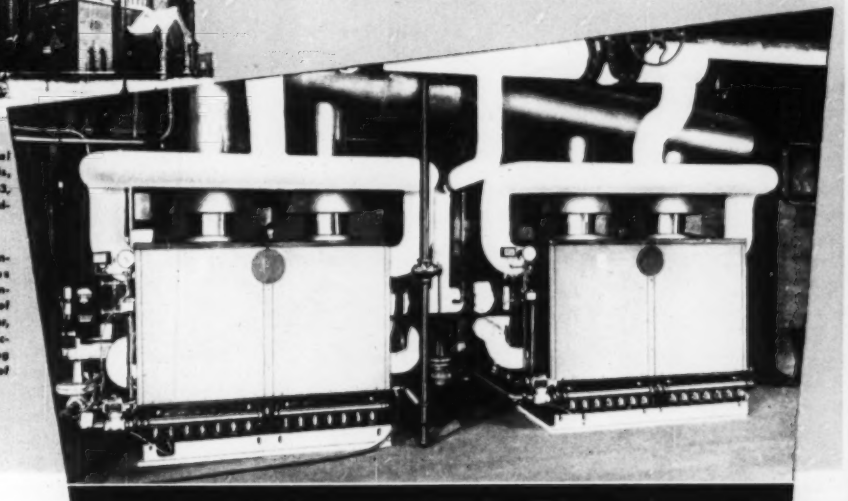
# AMERICAN-Standard

**First in heating . . . first in plumbing**

## Flexibility of dual boilers solves heating problem of 87-year old Michigan church

**Park Congregational Church, Grand Rapids, Michigan. Built in 1863, it is one of the city's oldest buildings.**

**Here are the newly installed Standard Gas Boilers. The job was under the supervision of Vernon Dean, Engineer, and the Heating Contractor was Beach Plumbing and Heating Co., both of Grand Rapids.**



**TWO 4-G STANDARD GAS BOILERS *for efficiency and economy!***

While it is one of the oldest buildings in Grand Rapids, the Park Congregational Church, built in 1863, has modern ideas about heating.

The problem confronting this interesting church was how to heat its building so that it would be comfortably warm in both mild and severe weather . . . and economize on fuel while doing it!

A solution was found in the installation of *two* 4-GS-15 Standard-Gas Boilers which permitted the desired flexibility through the operation of one or both units, thus giving greatly increased economy during mild weather, as well as perfect comfort in coldest weather.

Designed by gas heating experts of long experience, the Standard Gas Boiler is an outstanding example of good engineering and manufacturing skill.

Heating surfaces, burners, controls and other essential features are coordinated to assure maximum heat output with lowest operating and maintenance cost.

Type 4-G Boilers come in individual sections which may be conveniently carried through any ordinary doorway. They are easily and quickly assembled, due to accurately machined interchangeable parts.

Whether your need is for a single boiler, or for a battery of boilers, the Standard will give efficient, automatic gas heating in buildings of practically any type.

The Standard and other top quality heating equipment by American-Standard are sold through selected Wholesale Distributors to Heating and Plumbing Contractors. **American Radiator & Standard Sanitary Corporation**, P. O. Box 1226, Pittsburgh 30, Pa.

LOOK FOR THIS MARK OF MERIT

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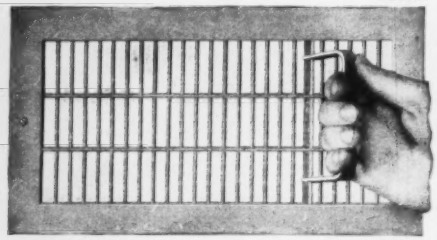
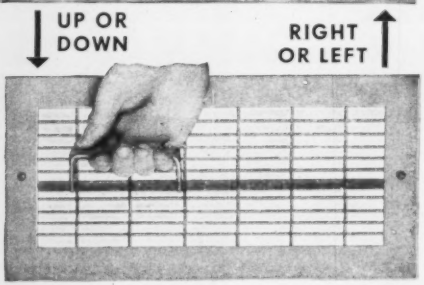
# INDEPENDENT

## "Fabrikated" WALL GRILLES for Commercial Installations

PROVIDE ADJUSTABLE DIRECTED AIR FLOW

321-A






311-A

Made to fit openings in even inches from 8" x 4" to 60" x 40"

Independent Fabrikated* Adjustable Grilles (patented), rigidly constructed with stamped steel rims and steel bars, are made with either vertical or horizontal grille bars. Grille bars are *adjustable* before or after installation; available also with bars permanently set for straight flow.

*Write for new Catalog No. 50 gives schedule of sizes, details and prices.*

**Always Leading — Always Progressing**

*Reg. U. S. Pat. Off.

**THE INDEPENDENT REGISTER CO.**

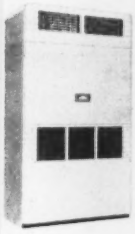
**3747 E. 93rd STREET · CLEVELAND, OHIO**


**HPAC 14—STORE AIR CONDITIONERS**—A "five year protection plan" is being offered by United States Air Conditioning Corp., 33rd & Como Ave., S.E., Minneapolis 14, on its 1950 line of store conditioners.

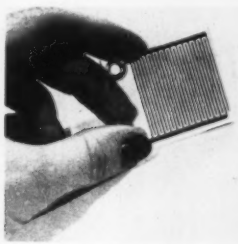
This plan includes a standard one year warranty and, in addition, provides a five year guarantee on the motor-compressor unit.

The new shell and tube condenser developed for the store conditioner is said to feature compactness, efficiency, and economy. Consisting of spiral finned coils contained in a small electrically welded dome, the condenser occupies a corner of the conditioner and may be used with city water or a cooling tower.

Winter operation is obtained by installing a heating coil in the plenum chamber. Capacities range from 3 to 7½ tons, for single or three phase operation.



Store Conditioner



Humidity Control Sensing Element

**HPAC 15—HUMIDITY CONTROLLER**—Minneapolis-Honeywell Regulator Co., 2604 4th Ave., S., Minneapolis 8, has developed a new humidity controller which is said to be accurate to within 0.5 percent RH.

The heart of the instrument is the sensing element which is about the size of a matchbook cover. The element consists of a clear plastic base on which is mounted conducting electrodes of pure gold leaf. The electrodes look like the teeth of a comb and are pressed onto the base. The entire element is coated with a thin solution of chemical salts. Operation is based on the fact that air conducts more electricity when moist than when dry. The sensing element measures minute changes in current carried by the salts between the teeth of the electrodes. Changes are amplified through electronic tubes and the amplifier may be used to operate recording or control equipment.

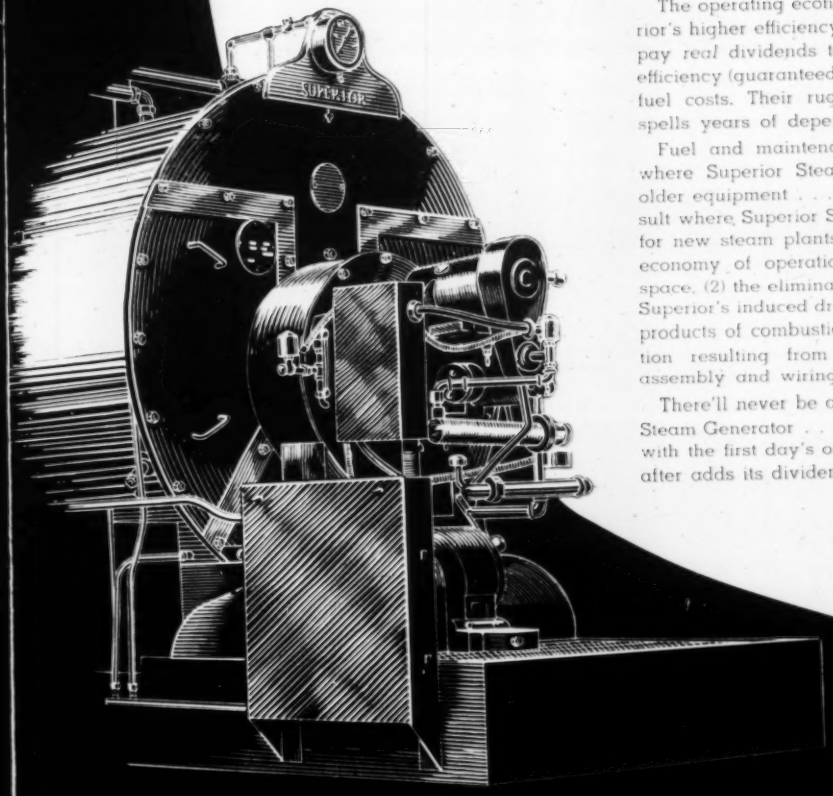
In addition to unusual accuracy, advantages of the controller are said to include imperviousness to dust, dirt, feathers, and similar material commonly found in factories, granaries, and hatcheries.

**HPAC 16—CONVECTOR RADIATION**—Airtherm Mfg. Co., 711 S. Spring Ave., St. Louis 10, has redesigned its line of convectors for hot water or steam heating systems to provide more attractive appearance and more rigid construction. Two new models have been added to the line, making a total of six now available. Each model is available in lengths from 20 to 64 in.; 4, 6, 8 and 10 in. depths; and 20, 24 and 32 in. heights.

All edges and corners of the front panel are formed to a 1 in. radius, and heating elements are constructed of seamless copper tubes, brazed into copper alloy headers. Nonferrous fins are mechanically bonded to the tubes.

# For STEAM DIVIDENDS Tomorrow

# Buy SUPERIOR STEAM GENERATORS Today




The operating economies which result from Superior's higher efficiency and long-lived dependability pay *real* dividends to their owners. Their thermal efficiency (guaranteed to exceed 80%) insures lowest fuel costs. Their rugged, heavy-duty construction spells years of dependable, trouble-free operation.

Fuel and maintenance savings are outstanding where Superior Steam Generators have replaced older equipment . . . but the greatest dividends result where Superior Steam Generators are specified for new steam plants. For here are added to their economy of operation (1) the economy of small space, (2) the elimination of an expensive stack (for Superior's induced draft requires only a vent for the products of combustion), and (3) simplified installation resulting from Superior's complete factory assembly and wiring.

There'll never be a better time to buy a Superior Steam Generator . . . because these dividends start with the first day's operation, and every day thereafter adds its dividend.

*17 sizes from 20 to 500 b.h.p. for pressures up to 250 p.s.i. Fully automatic with all grades of oil or gas. For complete data write for Catalog 204.*

Superior Combustion Industries, inc.

*Factory* Emmaus, Pa.
*Executive Offices* Times Tower, Times Square, New York 18, N. Y.

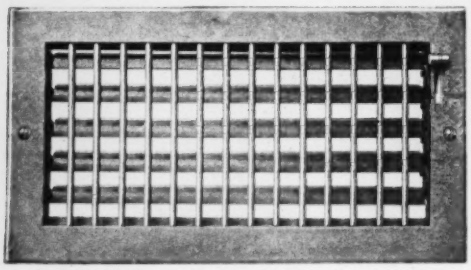
# "Streamliner"

## Meet the AUER

*—A New Kind of*

## High Velocity REGISTER

**Better Designed and Built! Longer Lasting!**



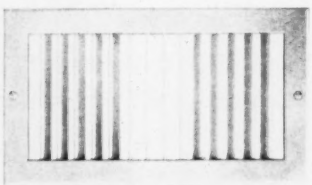
No. 1005V-HML. Single bank of adjustable bars, multi-louvre valve.

Full flexibility for multiple deflection is furnished by these Streamliner registers and grilles. They provide correct diffusion for high velocity outlets in air conditioning, ventilating or cooling systems.

Bars are hollow moulded, beveled, perfectly formed, and smooth in contour. They are pivoted in the frame on special split sleeves, or expansion inserts, which furnish proper tension to hold bars firmly when set, yet allow easy adjustment to the desired angle with one simple tool. Bars are slightly "tear-drop" shaped like an airplane wing in cross-section, and pivoted at the exact center, so they can be turned completely around. Some users prefer to turn the thin edge outward for outlets (and the broader edge toward the flow of air) cutting resistance and turbulence to a minimum. Bars may be set at any angle, in any grouping. Shutters of multi-louvre valves are pivoted on rivets to prevent vibration. All Streamliner registers are equipped with gaskets. Write for Folder S-49 with sizes and list prices.

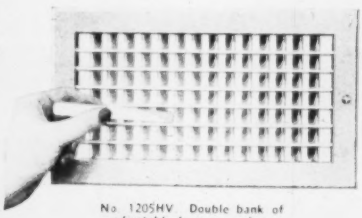
**8 MODELS**

The Series includes models with single bank of adjustable bars (vertical or horizontal), also with double bank of adjustable bars (vertical in front and horizontal in back, or the reverse); also all above four types with the addition of horizontal multi-louvre valves in the rear, controlled by lever on face of register.



No. 1005V. Single bank of adjustable bars, no valve.

Cross section of bar. Bars are absolutely quiet at high velocity.



No. 1205HV. Double bank of adjustable bars, no valve.

*Complete Auer Register Book — or Catalog "G" on perforated grilles — sent on request.*

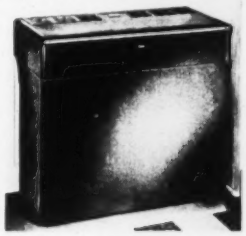
**The Auer Register Co., 6600 Clement Ave., Cleveland 5, Ohio**

**Auer REGISTERS**
**& GRILLES for AIR CONDITIONING & GRAVITY**


**HPAC 17—IMPULSE TRAP WITH STAINLESS STEEL BODY**—To provide additional resistance to the abrasive wear and corrosion encountered in severe steam trapping service, the "Yarway" impulse steam trap of Yarnall-Waring Co., Mermaid Lane, Philadelphia 18, is now made with a body of type 416 stainless steel bar stock.

Internal parts, as before, are made of stainless alloys. The stainless body replaces the cold rolled steel, cadmium plated body previously furnished for working pressures up to 400 psi and temperatures up to 450 F.

Impulse Steam Trap



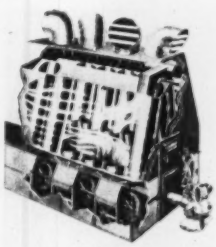
Room Conditioner

**HPAC 18—ROOM AIR CONDITIONERS**—The new line of room type air conditioning units of Philco Corp., Tioga & C Sts., Philadelphia 34, includes three $\frac{1}{2}$ hp air cooled, window sill models; three $\frac{3}{4}$ hp air cooled, window sill models; $\frac{3}{4}$ hp and 1 hp air cooled console types, and $1\frac{1}{2}$ hp and 2 hp water cooled console models.

Units feature a "pump-out" control for removing stale air and refrigeration equipment which may be removed readily. All models have hermetically sealed motor-compressor units.

**HPAC 19—DIRECT FIRED AIR HEATERS**—The series 8000 direct fired air heaters of Campbell Heating Co., 31st and Dean Sts., Des Moines, Iowa, are designed for gas, oil, or stoker firing and have capacities from 725,000 to 2,160,000 Btu per hr.

According to the manufacturer, the heat emission per square foot of heating surface is 3000 Btu per hr or less and the rated air volume produces a 75 deg temperature rise through the heater. The air volume can be varied to suit other conditions and motor size can be increased to accommodate "virtually any duct system."

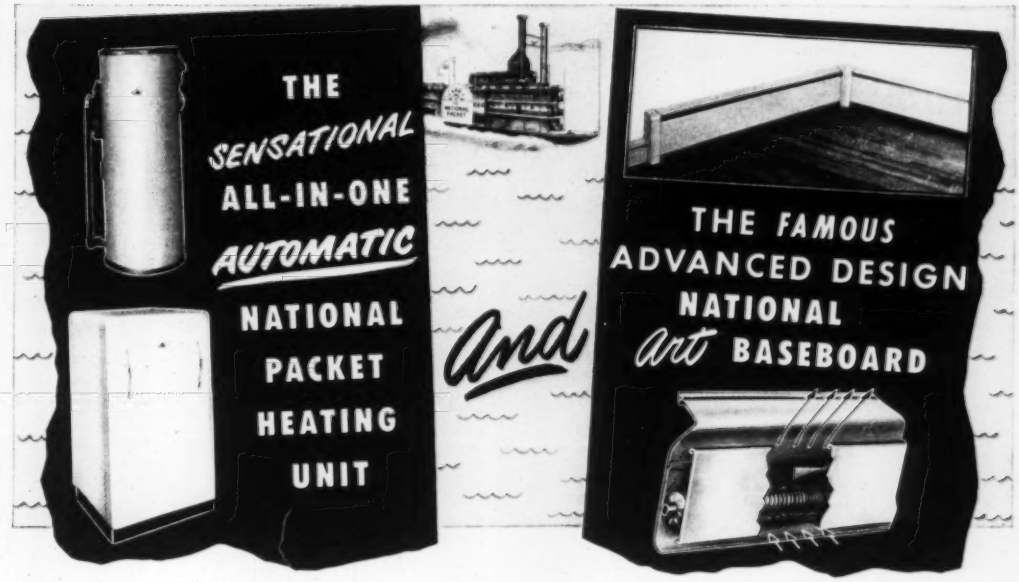


Air Heater

Speed Control Unit

**HPAC 20—SPEED CONTROL UNIT**—A new "Zero-Max" speed control device, which is infinitely variable from zero to maximum, has been developed by Reveo, Inc., 405 Thorpe Bldg., Minneapolis.

# NOW-The COMPLETE LOW COST
# NATIONAL PACKET
## HEATING SYSTEM!




## Compactness + Efficiency + Economy

This all-inclusive, easy-to-install National Packet Heating System is just what you have been looking for to meet today's demand for an inexpensive, complete hot-water heating installation for small homes, individual apartments, motels, diners, stores, etc.

Low price, low installation costs, exclusive engineering features, space saving and assured satisfactory performance make this complete National Packet Heating system highly profitable in every respect for all—Wholesaler, Heating Contractor and Owner.

### NATIONAL PACKET HEATING UNIT FEATURES

- High operating efficiency
- Built-in expansion tank and air eliminators
- Tankless domestic hot water using jet-flow principle
- National "Raytrol" simplified control system
- Unusually compact—attractive appearance

### NATIONAL *art* BASEBOARD FEATURES

- Combined radiant and convected heat at floor level
- Even heat distribution
- Inconspicuous—can be painted to match walls
- Clean heat—no dirt streaks—healthful heat
- More living space—no extra units to take up floor space

NRC

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THE NATIONAL RADIATOR COMPANY
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The National Radiator Company
Dept. HP
Johnstown, Pennsylvania

Please send me further information on the
- Complete National Packet Heating System
- National Packet Heating Unit
- National Art Baseboard

Name

Address

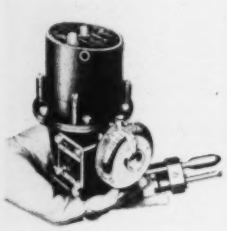
City Zone State

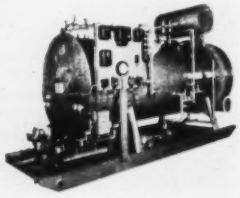
It is a torque conversion structure and its operating principle involves the use of crank motion on the input shaft creating linear motion which is absorbed on the output shaft by a series of one way overriding clutches. A leverage mechanism is placed between the two shaft structures for infinitely varying the length of the stroke from zero to maximum, providing an infinite speed variation from zero to 4 to 1 ratio.

The unit can be mounted in any position, is designed to provide level flow of power, to have instant response to change of speed, which can be made either while operating or stopped, and to provide excellent low speed as well as high speed performance. The smallest unit will handle loads up to 10 in. lb output torque.

**HPAC 21—GAS BURNER CONTROL**—A new "Gasapack" model 54 gas burner control has been developed by Automatic Products Co., 2460 N. 32nd St., Milwaukee 10.

The unit has a built-in pressure regulator, pilot filter, safety shutoff with automatic pilot, and is designed to permit multi-stage flame control with the use of a single contact thermostat. The burner spud and burner orifice can be furnished, so that installation requires only the tightening of two screws on a bracket. Compact in size and AGA approved, it can be made automatic by adding the company's automatic electric top, either at the factory or in the field. The capacity is 70,000 Btu per hr on gases of less than 800 Btu per cu ft, or 100,800 Btu per hr on gases of more than 800 Btu per cu ft.





Steam Generator

*Left:* Gas Burner Control

**HPAC 22—PACKAGED STEAM GENERATORS**—Extensive redesigns and improvements feature the 1950 line of "Steam-Pak" generators of York-Shipley, Inc., York, Pa.

All models are equipped with the company's patented iris shutter which is designed to provide precision control of burner air through the entire burner firing range. A new linkage assembly is used to facilitate the air-fuel ratio on all modulated units. New design features are said to provide a minimum length of oil piping and closer placement of heating components. A new method of lubrication for the atomizing air compressor has been incorporated and electronic type combustion safety controls are standard. All models utilize full welded construction of pressure vessels and high pressure boilers are now equipped with a double blowdown on each end of the boiler.

According to the manufacturer, a large number of other new features have been added to these generators which are designed for high or low pressure steam and are offered in capacities from 15 to 150 hp for oil, gas, or combination oil-gas firing.


# ALUMINUM

## SOLVES MANY TOUGH PIPING PROBLEMS

In recent years, aluminum and aluminum alloys have grown rapidly in importance as piping materials in many industries, including manufacturers of chemicals, foods, soaps and cosmetics, petroleums, textiles, explosives, rubber, paints and varnishes.

There are many reasons for this. Aluminum offers high strength, light weight, passivity when in contact with various corrodents, resistance to corrosion, absence of sparking characteristics, and low cost in comparison with other metals that have the same inherent qualities.

For example, in chemical plants, aluminum offers great resistance to corrosion, and it is passive to a large number of corrosive fluids where other metals tend to catalyze. Its corrosion products do not cause discoloration. This is important where maintenance of product color is of primary importance.

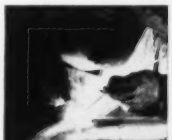
In food plants, aluminum resists the corrosive action of most food products such as acetic and nitric acids, oils, milk, beer, and fruit juices. It protects against color contamination and helps prevent rancidity.

In the petroleum industry, aluminum piping resists the corrosive action of hydrogen sulfide, sour crude oils, mineral oils and liquid fuels.

Aluminum piping materials are available in a variety of alloys including 2S, 3S, 61S, 63S, and Alclad 3S. Each is particularly suited for certain applications. And, since the physical properties vary with each alloy used, individual applications should be analyzed carefully to determine the correct alloy needed for the job.

So that every user can realize the advantages of all-aluminum piping systems, and also have the benefits of greater strength, greater safety and permanently leakproof joints afforded by welded construction, TUBE-TURN Welding Fittings and Flanges can be provided in all the alloys listed above. It's the most complete line available to industry.

*TUBE-TURN Welding Fittings and Flanges of wrought aluminum and aluminum alloys are available in many types and sizes, and in standard and extra heavy weights. They are now widely used in many industries.*



**FREE BOOKLET**

Write today for your free copy of the booklet "TUBE-TURN Aluminum Welding Fittings and Flanges." It contains information on every item in the line, as well as valuable data about the welding of aluminum piping.

**"Be Sure You See The Double tt"**

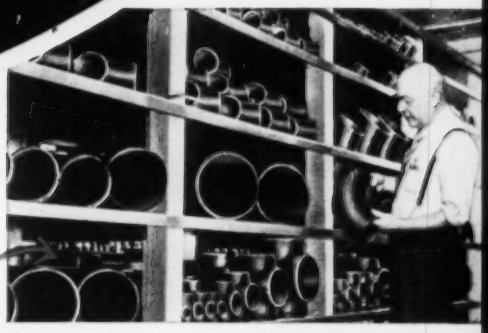
**TUBE TURNS, INC.**

LOUISVILLE 1, KENTUCKY

In all the world there's only one "TUBE-TURN" Welding Fitting as shown by this trade mark... the right mark for every need in welding fittings and flanges.

TUBE-TURN

TRADE MARK

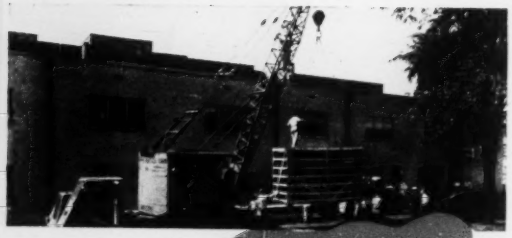


Your local distributor has a big stock. Get him on the phone!

**TUBE TURNS, INC., LOUISVILLE 1, KENTUCKY** DISTRIBUTORS IN ALL PRINCIPAL CITIES

DISTRICT OFFICES: NEW YORK • PHILADELPHIA • PITTSBURGH • CHICAGO • HOUSTON • TULSA • SAN FRANCISCO • LOS ANGELES

*In Canada . . . Tube Turns of Canada Limited, Chatham, Ontario*



HOW TO SAVE UP TO $5,000 ON AIR CONDITIONING

PAT. NO. 2,297,928

GOVERNAIR
COMPLETELY PACKAGED AIR CONDITIONER

Save water! Save space! Save installation time and money! Save operating costs! Yes, install Governair and *save from $50 to $200 for each ton* of the completely packaged Governair unit designed to fit your needs!

Experience proves Governair can save you up to $5,000 on a 50-ton Governair unit that gives greater dependability and more "engineered efficiency" than ever before!

If you want the best — if you want the most economical and reliable air-conditioning unit on the market . . . CHOOSE GOVERNAIR and SAVE!

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ORIGINATORS OF COMPLETELY PACKAGED AIR CONDITIONERS

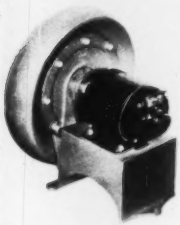
GOVERNAIR

UNIT COOLERS

GOVERNAIR CORPORATION • 513 N. BLACKWELDER • OKLA. CITY

**HPAC 23—GAS PRESSURE BOOSTERS**—A line of cast aluminum single stage, direct connected gas pressure boosters is available in 15 sizes to raise gas pressure over a range of from 3 in. water column to as much as 46 in.

Capacity of the boosters ranges from 3800 to 86,000 cfh and units are designed for continuous operation at full load and to offer no resistance to the free flow of gas when not under power. Boosters may be ordered with outlet pipes set to any one of seven tangential positions, and subsequent changes may be made in the field. Bryant Industrial Div., Affiliated Gas Equipment, Inc., 17825 St. Clair Ave., Cleveland.



Gas Pressure Booster

Humidifier

**HPAC 24**—INDUSTRIAL HUMIDIFIER**—The "Hum-O-Zone" is a packaged type, heavy duty humidifier for industrial use. It is available from Daffin Mfg. Co., Lancaster, Pa.

Utilizing a pump, spray nozzles, and a float valve, the unit is divided into chambers and water is atomized in the upper portion of the machine and syphoned into the air stream. According to the company, the syphoning eliminates the necessity for using a baffle arrangement. The machine discharges 750 cfm and both the air discharge and the moisture output are adjustable.

## WE HEAR THAT . . . .

**McDonnell & Miller, Inc.**, Chicago, has moved its home offices into a new building located at 3500 N. Spaulding Ave., Chicago. The new office building immediately adjoins the recently completed plant building. . . . **Tube Turns, Inc.**, Louisville, has appointed **J. T. Wing & Co.**, Windsor, Ont., as a distributor of welding fittings and flanges. The Canadian organization, which has a branch in Chatham, Ont., will represent both the American firm and its subsidiary, Tube Turns of Canada, Ltd.

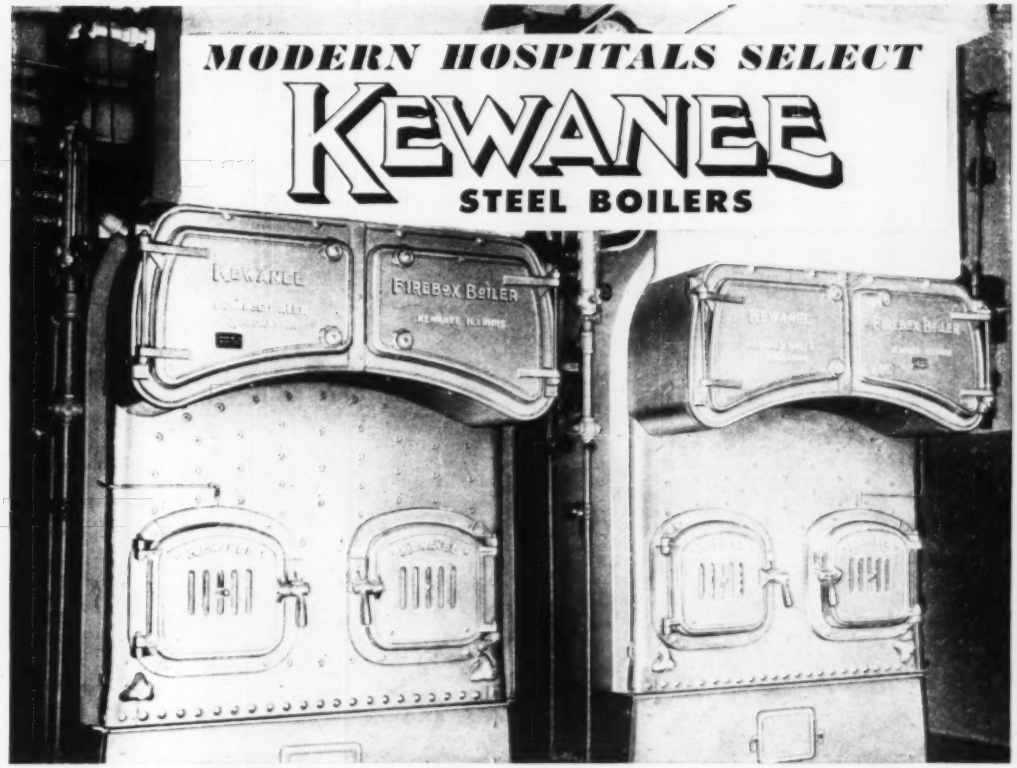
**A. O. Smith Corp.**, Milwaukee, is expanding its electric motor manufacturing facilities at Tipp City, Ohio, where

### REPORT OF ASHVE MEETING TO BE PUBLISHED

Last month, 320 members, ladies and guests of the American Society of Heating and Ventilating Engineers jammed the facilities of the Royal Muskoka hotel, in Ontario, Canada, during the society's semi-annual meeting.

Highlights of the affair included the presentation of 11 technical papers, committee meetings and various recreational activities. These will be covered in a report of the meeting, to be published in the ASHVE Journal Section next month.

# MODERN HOSPITALS SELECT KEWANEE STEEL BOILERS




## Complete Dependability Makes KEWANEE First Choice

COMMUNITY HOSPITAL, CLINTONVILLE, WIS.
*E. A. Stubenrauch, Architect • Quail Plumbing Co., Heating Contractors*
Installed are 2 No. 582 High Pressure Kewanee Firebox Boilers, 150 h.p. . . . 125 lbs. swp for rear stoker firing.

Dependability of heating equipment is a "must" in Hospitals . . . that's why you will usually find Kewanee "on the job" year after year in those installations where failures would be serious.

Built of sturdy steel plate, with extra stout stays and braces, the heavy duty Kewanees selected for this medium size Hospital in Clintonville, Wisconsin have all the characteristics which make the firebox boiler outstanding for rugged service.

KEWANEE BOILER CORPORATION
BOILERMAKERS 80 YEARS KEWANEE, ILLINOIS
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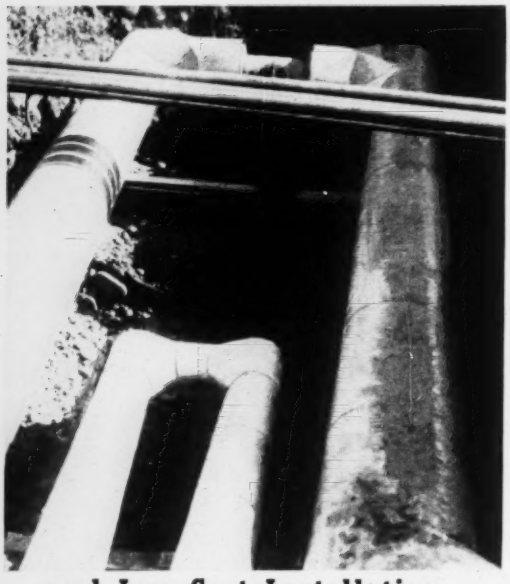
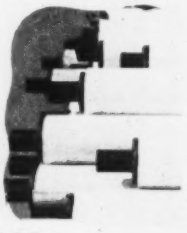
D.I.P.
REG. U. S. PAT. OFF.

**Pre-Sealed Protection Built-In at Factory**



**- and Low Cost Installation Saves Time, Trouble and Work**

Wherever you have a problem of conveyance of hot-water, steam or refrigerants, you can specify DURANT INSULATED PIPE with complete confidence in securing long range economy.



The combination of the best quality moulded insulation completely protected by non-porous asphalt merits the preference of architects, engineers, and contractors who have investigated the scientifically engineered construction methods employed in the fabrication of D. I. P.

Economy starts with installation. D. I. P. requires no tile, masonry, or sub-drains. Field joint work is simple, yet corrosion and electrolysis are eliminated. Low maintenance costs result in further economy over long years of dependable service.

Complete detailed information and engineering data on standard piping and special fittings will be furnished on request. Our representatives in principal cities are at your service.

PRE SEALED
REG. U. S. PAT. OFF.

**DURANT INSULATED PIPE COMPANY**
1015 Runnymede St. East Palo Alto, California

the firm recently bought **Whirl-A-Way Motors, Inc.** The Tipp City operation now becomes the eastern motor division of A. O. Smith, with **D. L. Mills**, former president of Whirl-A-Way, as manager. A new factory is to be built this summer.

In keeping with its policy of erecting modern new sales and service offices throughout the country, **Fairbanks, Morse & Co.**, Chicago, has now completed its fifth such construction project. This is the new building housing the Chicago sales and service branch at the corner of S. State St. and 16th St., Chicago. Representing an investment in excess of $1\frac{1}{2}$ million, the building includes not only the Chicago branch office but a modern scale shop, diesel repair shop, warehouse, and display floor.

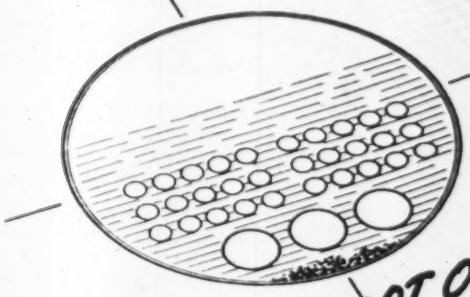
In addition to its primary work of manufacturing seamless and welded tubing, **Babcock & Wilcox Tube Co.**, Beaver Falls, Pa., is now fabricating tubing on a limited basis. The type of fabrication handled includes bending, end forming, flash-butt-welding, and the production of various cross section shapes and other specialty tube work. ..... In the first four months of this year, sales of air conditioners produced by **Philco Corp.**, Philadelphia, were 57 percent ahead of a year ago. One important factor in the notable sales increase, says the company, is the substantially lower prices for 1950 models.

The advisory committee to the **Research Div., New York University College of Engineering** recently held its second annual meeting. The division is under the direction of **Dr. Harold K. Work**, and projects now in progress at the university's engineering college include atomic waste disposal, meteorological studies on atmospheric energy and general circulation, heat pump investigations, smoke dispersion, paint investigations, titanium studies, and mechanical vibrations.

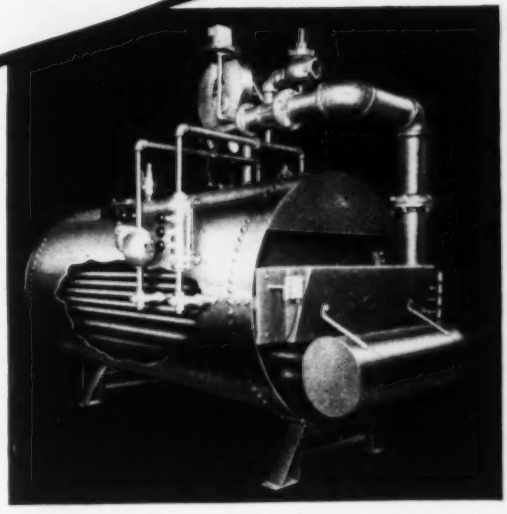
**Fisher Governor Co.** recently held a three day international sales meeting at its home office and factory in Marshalltown, Iowa. Some 125 representatives, sales engineers and their wives from company offices throughout the United States, Canada and Mexico were in attendance as guests of the firm.

The **American Gas Association's** annual Progress Award for Gas Summer Air Conditioning consists of a copper plaque on a polished walnut panel and a check for $1000 to be used at the discretion of utility management for a joint activity to be enjoyed by the entire personnel of the winning company, or for distribution to those most responsible for the achievement. Any gas utility member of AGA is eligible for the contest.

**Davidson Fan Co.**, Newton, Mass., has appointed **C. H. Bevington Co.**, 330 S. Wells St., Chicago, representative in that area for the sale of its roof type ventilators. ..... ..... **Mitchell Mfg. Co.**, Chicago, reports that shipments of its room air conditioners during the first quarter of this year exceeded by more than 300 percent sales in a like period last year. Orders on hand are said to total almost five times the total shipments to distributers in 1949, which was the company's biggest year in room air conditioner sales.



# EVERY SQUARE FOOT OF HEATING SURFACE IS WATER BACKED... 100% EFFECTIVE



The gas fired heating tubes in a Sellers are completely submerged. Heat has only one place to go . . . into the water. Furthermore, insulating scale gets little chance to build up for it is continually cracked off as tubes expand and contract under intermittent firing. And inner tube walls are kept free from dead gas film due to scouring action of high velocity gases. Our bulletin No. 1206-C gives full details about the 12 sizes available. Write today.

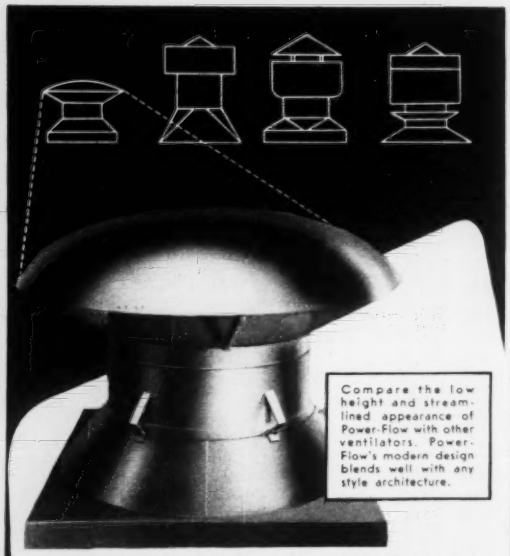
**Sellers**

**IMMERSION STEAM BOILER**

**SELLERS ENGINEERING CO.**

4876 N. Clark St., Chicago 40, Illinois

*Blast Heaters—Immersion Automatic Water Heaters—Air Heaters—Combustion Units—Industrial Gas Burners—Immersion Tank Heaters—Vertical Steam Boilers—Gas Combustion Equipment*


Compare the low height and streamlined appearance of Power-Flow with other ventilators. Power-Flow's modern design blends well with any style architecture.

**CONTROLLED VENTILATION**
*Plus*
**STREAMLINED GOOD LOOKS**

The DeBothezat Power-Flow Roof Ventilator is a motor-driven fan in a weatherproof housing. It provides CONTROLLED ventilation at all times, regardless of outside weather conditions. These rugged, efficient ventilators deliver up to 40,900 CFM. They exhaust more air per brake horsepower than other ventilators, are quieter in operation and more economical in first cost. Non-overloading power characteristic prevents motor burn-out. DeBothezat Power-Flow Roof Ventilators can be used with or without duct system. Available with fan wheels from 16" through 48" in diameter.

**ALL PARTS EASILY ACCESSIBLE**

Power-Flow Roof Ventilators, sizes 16" through 36" are hinged in two places, for easy inspection and lubrication. Larger models (42" and 48") permit access to fan, shaft and motor by means of easily removable door.

*Free Catalog*

Send today for 16-page catalog complete with illustrations, dimensions and specifications for all Power-Flow Roof Ventilators. Address Dept. H-750

**DE BOTHEZAT FANS DIVISION**
**American Machine and Metals, Inc.**
**East Moline, Illinois**

***Power-Flow***
**ROOF VENTILATORS**

The distribution of "Recold" commercial refrigeration and air conditioning equipment in Oregon and Washington is being handled by **Refrigerating & Power Specialties Co.**, according to **Refrigeration Engineering, Inc.**, Los Angeles. The new distributor, who will handle the sale of equipment in its Portland, Tacoma and Seattle offices, has headquarters in San Francisco. The firm is now exclusive distributor for Refrigeration Engineering in the northwest, replacing **Refrigerative Supply, Inc.**, which has handled the line for several years.

Over 100 dealers and wives recently gathered at the factory of **Steel Products Engineering Co.**, Springfield, Ohio, for a special prevue of the new "Combustioneer" oil burners and oil fired furnaces. ..... **Hajoca Corp.** has moved from its former Chester, Pa., location at 4th and Morton Sts. to its newly constructed branch office and warehouse at 2nd and Broomall Sts. The new headquarters marks another milestone in the company's expansion and remodeling program, in progress among its 32 Atlantic seaboard branches since the end of the war.

During the first half of the current fiscal year of **Remington Air Conditioning Div., Remington Corp.**, Cortland, N. Y., which ended on April 30, shipments of air conditioners were 52 percent greater than for all of fiscal 1949. In terms of dollar volume, shipments were 260 percent of the volume billed during the same six months of the previous year. That 1950 will be a record breaking year for the room air conditioner industry is indicated by the fact that a number of manufacturers, including Remington, have put their distributors on allocations.

**Dryomatic Corp. of America**, formerly of Baltimore, has been reorganized and is now known as **Dryomatic Corp.** The plant and main offices are located in Alexandria, Va., where three air drying units are being manufactured. The company plans to construct models to meet special industrial needs, and an enlarged sales program is under way.

United Artist Productions recently called upon **Santa Fe Tank & Tower Co.**, Los Angeles for assistance in promoting its movie, Sierra. In the lobby of the United Artists Theater in downtown Los Angeles was a display of industrial wood products manufactured by Santa Fe. The purpose, of course, was to illustrate the relative importance of Sierra redwood and its application to American industry and to tie in the movie.

**Cyclotherm Corp.**, Oswego, N. Y., has opened its own branch offices at 60 Hudson St., New York City with a sales and service department under the direction of **Emil Zisek.** Nine recently appointed distributors and their territories are: **Rumbold and Co., Inc.**, Atlanta—for Georgia; **Phillips Engineering Co.**, Detroit—for Michigan; **Bingham and Risdon Co.**, Green Bay—for Wisconsin; **General Industrial Supply Corp.**, Fort Worth—for western Texas; **Royster H. Johnson Co.**, Charlotte—for North and South Carolina; **Dempster Bros.**, Knoxville—for Tennessee; **Keady Sales Corp.**, Chicago—for northern Illinois; **Air Conditioning Engineers, Inc.**, Mobile—for lower Alabama, Mississippi, and northern Florida; **Flagg, Brackett & Durgin, Inc.**, Boston—for New England.

The new corporate name of **Overhead Heaters, Inc.**, has been adopted and registered by the former **Shafco Distributing Corp.** Executive offices are being maintained at 1354 Book Bldg., Detroit, with factory and warehouse locations at Kalamazoo, Mich. National distribution of the company's product will be continued under the new trade name of "Shafconaire" overhead heaters.

**U. S. Air Conditioning Corp.**, Minneapolis, has named twelve additional direct factory dealers throughout the country. They are: **Gary Gray Machinery & Tools**, Cleveland; **Chappelle Sheet Metal**, Terre Haute, Ind.; **E & S Engineering Co.**, Jackson, Tenn.; **Rigid Contracting & Air Conditioning Co.**, Brooklyn; **South Hills Refrigeration Service**, Pittsburgh; **Golleher Refrigeration**, Mission, Tex.; **National Hardware & Electric Co.**, New Braunfels, Tex.; **Commercial Refrigeration Co.**, Hamilton, Ohio; **Bunteen Refrigeration & Air Conditioning Service**, Chicago; **Dowdle Air Conditioning & Heating Co.**, Denver; **Gray & Son, Inc.**, Wooster, Ohio; and **Automatic Heating Co.**, Youngstown, Ohio.

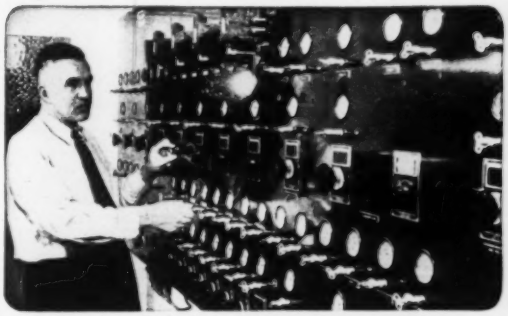
With the introduction of the new "Lipman" L-310 cooler, **General Refrigeration Div., Yates-American Machine Co.**, Beloit, Wis., now offers a complete line of air conditioners up to the 15 ton package unit. .....

Unusual flame resistance has been incorporated in a new insulation product, "Cellufoam Airflow", according to **Masonite Corp.**, 221 N. LaSalle St., Chicago. The product has been developed especially for application in air conditioning systems where a high degree of surface flameproofing is considered desirable.

A slide rule type of instrument for determining the important properties of air is now available from **Calculator Specialties Co.**, 122 S. Michigan Ave., Chicago 3. Two scales on the slide rule combine the relationship between dry bulb and wet bulb temperature to obtain the relative humidity reading. Two other scales combine the relationship between dry bulb and dew point temperatures to obtain the relative humidity reading, and by using one or the other of these two sets of scales, the three temperature values may readily be determined. With these values known, the device may be used to determine other properties such as sensible heat, volume, total heat, grains of moisture, latent heat, volume of vapor, and vapor pressure.

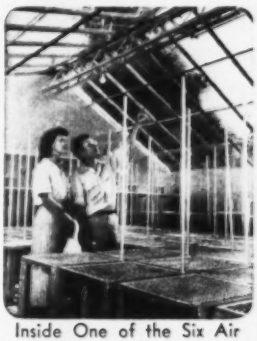
A new line of trailer mounted, portable compressors has been developed by **Gardner-Denver Co.**, Quincy, Ill. Designed especially for operating small air tools on miscellaneous service jobs, units are said to have ample capacities for use with paint spray guns, chipping hammers, light paving breakers, spaders, tampers, and similar pneumatic equipment. The unit, which includes an air cooled compressor and gasoline engine, is arranged for towing behind a car or service truck.

**Handy & Harman**, 82 Fulton St., New York 7, is distributing a silver brazing alloy package through its dealer organization. The package contains 5 oz of 1/16 in. diameter "Easy-Flo-45" wire, a torch brazing instruction booklet, and a folder covering the advantages of this brazing. A list of dealers is available from the company.

**$407,000 PHYTOTRON LABORATORY EQUIPPED with Frick Refrigeration**

The great new plant research laboratory of the California Institute of Technology, at Pasadena, uses two Frick refrigerating machines for cooling four rooms and air conditioning 13 others, plus six greenhouses. Simulated weather conditions are automatically controlled with ease and accuracy. Installation by the Independent Refrigeration Co., of Los Angeles.



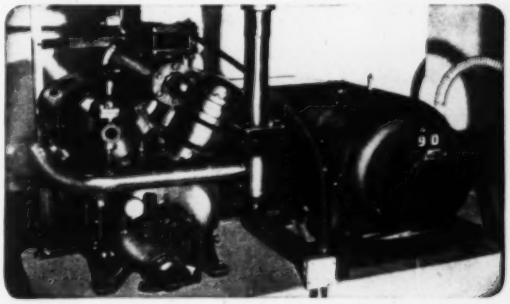
Inside One of the Six Air Conditioned Greenhouses

Let us quote on the cooling equipment you need—whether for air conditioning, ice-making or other refrigerating work.

DEPENDABLE REFRIGERATION SINCE 1882
FRICK CO.
WAYNESBORO, PENNA. U.S.A.

*Also Builders of Power Farming and Sawmill Machinery*

Frick NEW "ECLIPSE" Compressor at the Phytotron



# WHO'S WHAT

**Charles A. Butcher** has joined **Worthington Pump and Machinery Corp.**, Harrison, N. J., as assistant to the president. He was formerly general manager of Crocker-Wheeler Electric Mfg. Co. and vice president of its successive parent companies, Joshua Hendy Corp., and Elliott Co. . . . **Dr. Frederick L. Hovde**, president of Purdue University since 1946, has accepted the chairmanship of the **Building Research Advisory Board**. His appointment fills the vacancy resulting from the death of **Dr. Frank B. Jewett** last year.

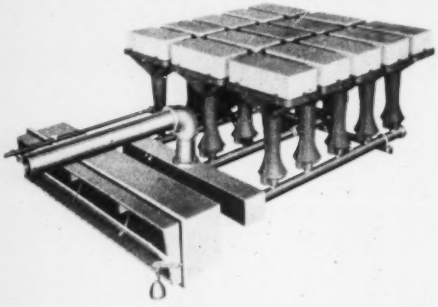
**Harold B. Ressler** is now first vice president of **Joseph T. Ryerson & Son, Inc.**, Chicago steel distributor. He had been vice president and general manager of sales since 1932. **C. L. Hardy**, former assistant vice president, has been named assistant to the president and **Thomas Z. Hayward** is general manager of sales for the group of 13 Ryerson steel service plants. He had been assistant general manager of sales since 1944.

The new chief metallurgist of magnesium products for **Aluminum Co. of America** is **Robert T. Wood** who, since 1940, has been chief metallurgist for American Magnesium Corp., Cleveland, an Alcoa subsidiary. Next month, **Dr. Kent R. Van Horn** will become associate director of research for Alcoa. At present, he is an assistant director of research for the company, and has been in charge of the branch laboratories in Cleveland. . . . Last month, **James F. Lincoln**, president of Lincoln Electric Co., was given an honorary degree at the spring quarter commencement exercises of Ohio State University.

A chemical industry correlating committee has been organized by the **American Standards Association**. **J. G. Henderson**, Carbide and Carbon Chemicals Div., Union Carbide and Carbon Corp., is chairman. **James C. Lawrence**, engineering dept., E. I. duPont de Nemours & Co., is vice-chairman, and **C. E. Hilton**, of the ASA, is secretary. The committee will serve to coordinate the views of the chemical industry on those standards that deal with equipment and products the industry uses in construction, maintenance, and operation of its production facilities. Its studies are expected to include pipe fittings and flanges, thin-wall tubing, pressure vessels, and similar products.

**Fairbanks, Morse & Co.**, Chicago, has named **Gordon R. Anderson** as general manager of its Freeport Works, Freeport, Ill. He succeeds **Lee Madden**, retired. He joined the company in 1922 and since 1946 has been manager of engineering. **J. F. Weiffenbach**, who has been chief engineer of the diesel locomotive division, takes over Mr. Anderson's former position. **Donald L. Harwood** has been promoted from assistant purchasing agent to purchasing agent of the company.

**Hamilton Merrill**, vice president and director of **Manning, Maxwell & Moore, Inc.**, Bridgeport, Conn., has been appointed vice president in charge of the Con-

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SERIES F600
GAS BURNER

- Designed for LOW GAS PRESSURE
- INTERCHANGEABLE PORTS
- RADIANT fire brick top
- NO COMBUSTION CHAMBER required
- Will NOT VIBRATE
- LOW draft loss
- ANY SHAPE and SIZE
- INTEGRALLY MOUNTED pilots

THE WEBSTER ENGINEERING CO.
P. O. Box 2168 Tulsa, Oklahoma

solidated-Ashcroft-Hancock Division of the company. . . . **H. O. Holland** has been director of sales since 1947 for **Automatic Steel Products, Inc.**, Canton, Ohio. He is now vice president in charge of sales of all divisions of the corporation. **John E. Carnahan** is the new vice president of the Spun Steel Division. . . . **J. F. Knoff** has been promoted to assistant general sales manager of **Airtemp Div., Chrysler Corp.**, Dayton, Ohio. He joined the division as district representative in the New Orleans region in 1945. Since September 1948 he has been sales director and is now succeeded by **A. F. Ward**, who has been with the division since 1940, when he joined the St. Louis regional staff.

**Frederick J. Sullivan**, branch manager at Providence, R. I., for **Crane Co.**, Chicago, has been promoted to assistant branch manager of the Boston office. He succeeds **T. F. McCabe** who has resigned. **Henry M. Bristol**, of the Springfield, Mass., branch, is the new manager at Providence. . . . **Combustioneer Div., Steel Products Engineering Co.**, Springfield, Ohio, has named **Laverne N. Zimmerman** district manager for the New England States. He has been associated with the heating industry for many years.

**D. G. Spahr** has joined the sales organization of **L. J. Mueller Furnace Co.**, Milwaukee, as a sales specialist on "Climatrol" gas fired boilers. He will confine his activities to promoting radiant and radiator heating and special boiler hot water supply applications. He has been engaged in training activities for the Institute of Boiler and Radiator Manufacturers. . . . The general machinery division of **Allis-Chalmers Mfg. Co.**, Milwaukee, has named three new district office managers. They are: **J. H. Burrus**, manager of the Milwaukee district; **U. E. Sandelin**, Portland district; and **Stephen C. Bacon**, Seattle district. Mr. Burrus, since 1949 manager of the Portland district, succeeds **H. A. Balding** who has retired. Mr. Sandelin has been manager of the Seattle district since 1945, and Mr. Bacon has been associated with the Seattle office since 1938.

**Stuart Hatch**, formerly sales representative in the St. Louis office, has been transferred by **Spang-Chalfant Div., National Supply Co.**, Pittsburgh, to the Pittsburgh district sales office. **R. S. Skinner**, Los Angeles sales representative, has been transferred to the St. Louis office. . . . **Kaylo Div., Owens-Illinois Glass Co.**, Toledo, has re-established its Atlanta branch, transferred its Dallas branch to Houston, and will increase southwest coverage by opening a new office in Oklahoma City. This expansion program involves the appointment of three new sales engineers and the transfer of **Carl Ramien**, sales engineer, from Chicago to Atlanta. **J. R. McAdams** has taken over the Chicago post and **J. K. Dixon** is the new Houston sales engineer. **E. E. Drake** has been assigned to Oklahoma City.

**A. F. Boucher** is the new district manager in the Detroit area for **Lincoln Electric Co.**, Cleveland. He has been transferred from Milwaukee where, since 1947, he has been district manager. **I. R. Bartter**, district manager in Grand Rapids since 1945, has taken over the Milwaukee post. . . . **Walter H. Bramman** has joined the sales force of **Black & Decker Mfg. Co.**, Towson, Md., and will work with the company's distributors in Montana,


TITUSVILLE

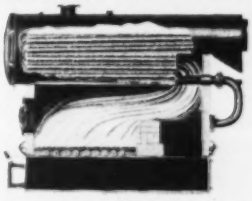
*Compact All Welded*

HIGH FIREBOX

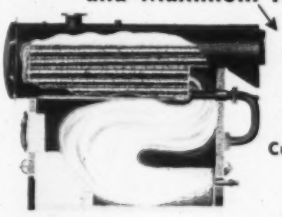
STEEL HEATING BOILERS

Cutaway view to show Type CC Compact Boiler (hand fired)

1. Large Grate Area
2. Large Furnace Volume
3. Large Disengaging Area
4. Large Steam Volume
5. Long Heat Travel



These Features Assure More Savings in Fuel and Maximum Heat Output



1. Long Flame Travel
2. Max. Furnace Volume
3. Reasonable Heat Release
4. Highest Efficiency
5. Longest Life

Cutaway view to show Type CM Compact Boiler (mechanically fired)

*Write for complete informative Bulletin B-3000B for CM & CC Types*

Titusville manufactures a Complete Line of High and Low Pressure Fire and Water-tube Boilers to meet all capacity and pressure requirements. *Request bulletin "Meet the Titusville Family."*

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## on how to drain corrosives

This 12-page bulletin tells you how, why and where you should use Duriron acid-proof drain equipment for corrosive wastes.

It includes—the physical, mechanical and corrosion-resisting properties of Duriron compared to other materials ...engineering data on Duriron equipment ... application in chemical laboratories, engraving plants and industrial acid waste systems ... proper installation practice.

*Find out how you can protect your waste disposal system against costly corrosion. Use the coupon, today.*

**The Duriron Co., Inc.**
Dayton 1, Ohio
***Branch Offices in Principal Cities***

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CORROSION RESISTING ALLOYS & EQUIPMENT

DURCO ADV. 90 GM

**The Duriron Co., Inc., Dayton 1, Ohio**

Gentlemen:

Please send me your free bulletin 703.

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the eastern part of Washington, and all of Idaho east of Boise. He will be part of the Seattle sales force managed by **P. W. Lund. J. H. Webb**, who formerly covered Mr. Bramman's territory, will now be in the Seattle area.

**Yarnall-Waring Co.**, Philadelphia, has made a number of personnel changes in its district sales territories. **Lytton C. Musselman** is in charge of the Los Angeles district office at Huntington Park, Calif., and **Power Engineering Co.** is handling representation in Salt Lake City. **Wallace J. Agren** is now a sales engineer in the Chicago branch, replacing **F. C. Harry Vaughan**, deceased. **R. W. Westlake** is a sales engineer in the Cleveland office and **Andrew M. Ritter** is managing the Detroit branch, replacing **Charles H. Grosjean** who has returned to the New York territory. **Lyle G. Chase, Jr.** has joined the sales engineering staff of the New York office.

**Frigidaire Div., General Motors Corp.**, Dayton, Ohio, has opened a new branch at 811 E. Vienna Ave., Milwaukee. **Paul W. Guthrie**, former comptroller of the Chicago branch, is in charge. The new branch headquarters incorporates general sales and service offices, a warehouse, and a parts department. It will serve Wisconsin, the upper peninsula of Michigan, and segments of Minnesota and Iowa.

**Minneapolis-Honeywell Regulator Co.**, Minneapolis, has opened an office in Puerto Rico to handle sales, service and installation in that island as well as the Dominican Republic and the Virgin Islands. **Edward Smart**, who has been living in San Juan for the past several years and has been with an organization handling the company's products, has been named district manager of the new office. A new mid-Atlantic region with headquarters in Philadelphia has been formed and comprises the Philadelphia, Washington, Baltimore, and Richmond territories. The new region was formerly a part of the eastern zone with headquarters in New York City. **Arnold Michelson**, eastern regional vice president will continue to supervise the new region which is being managed by **Albert H. Koch**, former branch manager of the Philadelphia office. **Lloyd S. MacGann**, formerly Baltimore branch manager, has been transferred to Philadelphia as regional sales manager for the company's commercial division and is succeeded in Baltimore by **Merritt Eusey**, Albany branch manager.

**Penn Industrial Instrument Corp.**, Philadelphia, has named **George D. Keller** as manager, sales-engineering department. His experience includes three years in similar work with a prominent instrument manufacturer, four years of engineering and production work with the War Department, and four years in the sales and engineering department of Worthington Pump & Machinery Corp.

**Frank L. Myers** is now general sales manager of the **Fibrous Products Div., Union Asbestos & Rubber Co.**, Chicago. Prior to joining the company in 1948, he was with Owens-Corning Fiberglas Corp. and was active in heating, ventilating and air conditioning circles. . . . **Harold B. Leland** has been appointed vice president-manufacturing, **Hood Rubber Co.**, Watertown, Mass., a division of **B. F. Goodrich Co.** He had been manager of employee and industrial relations at Hood since 1937.

TYPE
HS PUMP

**Economy** from the beginning—yes, you save at both ends when you invest in the Skidmore Type HS Condensation Pump. The first cost is not only small in comparison, but this pump will do the job required year after year with real economy. Like all Skidmore Pumps the Type HS is built of the same fine materials and will give the same dependable service that has made the name "Skidmore" famous in Pumps for over a quarter of a century—yes, this HS Pump "Pays Off" from the start!

Write for Bulletin 14-A for complete engineering data. See why this Skidmore Pump offers more in efficiency and lower operating cost.

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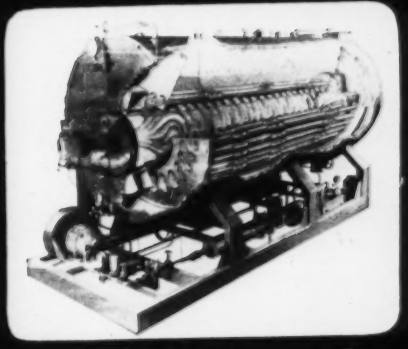
- SPACE
- LABOR
- TROUBLE

*MODERNIZE*
*Your Steam Plant*
*with a • Clean*
*• Efficient*
*• Fully Automatic*

**AMESTEAM GENERATOR**

*Thousands in use*



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**AMES IRON WORKS**

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Builders of Better Boilers since 1848
Manufactured under
License in Canada by VOLCANO, Ltd., Montreal, P. Q.

**A. S. Glossbrenner,** recently elected vice president in charge of operations, **Youngstown Sheet and Tube Co.,** Youngstown, Ohio, has named two assistants. They are **William H. Yeckley,** formerly general superintendent of the Campbell work steel plant, blast furnaces, and Struthers works, and **Dr. Karl L. Fetters,** formerly special metallurgical engineer ..... **Herbert L. Wagner** is now vice president in charge of engineering of **Detroit Stoker Co.,** Monroe, Mich. He remains at the Detroit office where, for some time, he has had the title of chief engineer, following the retirement of **Royce L. Beers,** former vice president in charge of engineering. Mr. Beers is still associated with the company as a director.

**Stanley J. Pachyn** has joined **Combustion Control Corp.,** Cambridge, Mass., as assistant sales manager with headquarters in the Chicago office. He was formerly associated in various engineering sales capacities with Iron Fireman Mfg. Co. and the Industrial Div., Bryant Heater Co. **Rody G. Capron** is now associated with the firm as west coast sales manager, with headquarters in San Francisco. He has been associated with the oil burner industry for the past 15 years and was formerly with the Industrial Oil Burner Div., Enterprise Engine & Foundry Co. More recently he served in a supervisory sales capacity with Gilbert & Barker Mfg. Co. **Dana Fisher** has moved from the Cambridge sales office to the New York office.

**Murray W. Sales & Co.,** Detroit, has elected **N. Tyler Tifft** president. He succeeds **Donald G. McLeod,** who has retired. . . . With headquarters in Pittsburgh, **W. R. Ryburn** is managing sales of seamless products for **Spang-Chalfant Div., National Supply Co.,** Pittsburgh. For the past three years he has been manager of National Supply's drilling equipment sales at the company's general sales offices in Toledo. He succeeds **R. M. Burk** who recently left the company to enter the oil business. **R. J. Casterton** has been transferred to the Boston office as sales representative. He had held a similar position in Pittsburgh.

**Hardy S. Ferguson,** a well known pulp and paper mill engineer, has joined the pulp and paper engineering division of **H. K. Ferguson Co.,** industrial engineers and builders, as a consultant. He recently terminated his own engineering concern which had gained an international reputation for engineering and designing pulp and paper facilities. . . . Representation in the central Indiana territory of **Illinois Engineering Co.,** Chicago, is now being handled by **W. H. Dwyer Associates,** Architects & Builders Bldg., Indianapolis. **Charles E. Markland,** 1106 W. Church St., Champaign, Ill., is the new representative in the central Illinois territory.

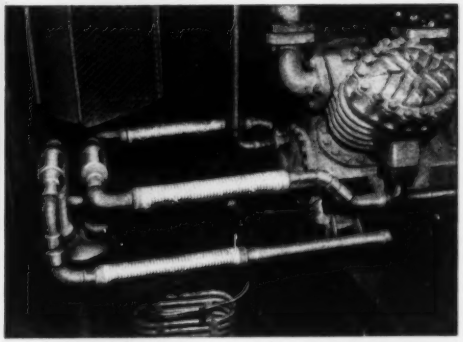
**Roland W. Burt** is the new sales manager of the Chicago plant of **Joseph T. Ryerson & Son, Inc.,** Chicago, succeeding **Thomas Z. Hayward,** former assistant general manager of sales and acting sales manager of the Chicago plant, who has been promoted to general manager of sales. Mr. Burt began his career with the company in 1923.


Another Problem SOLVED

ELIMINATING COMPRESSOR VIBRATION

with Bendix

Eclipse Flexible Metal Hose



Twenty-four-hour operation of a huge icebox for cold testing (to −85° F.) aircraft instruments, plays a vital role in maintaining the supply line to today's multi-engined and supersonic aircraft. Greater assurance of a continuous duty refrigerating plant was given with the installation of Bendix Vibration Reducers for absorbing compressor vibration. Manufactured from seamless drawn tubing, the deep parallel corrugations and uniform wall thickness assure maximum flexibility and service life. Bendix Vibration Reducers in standard sizes—all chemically cleaned and sealed—are available from stock. Special assemblies can be engineered to your requirements. Write today and let our engineers work out your problem with you.

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BENDIX AVIATION CORPORATION
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Equipment that's too **hot to touch** is obviously a **soft touch** for the escape of power-laden Btu's . . . a **fat touch** on your fuel dollars!
Check power losses, cut production costs, raise efficiency and employee morale with fuel-saving, CAREY Industrial Insulation.

**And to keep Btu's on the job at high temperatures—here's a new, improved insulation**

## Carey Tempchek

a brand new material with a low K-factor, rugged strength, excellent "handle-ability," and a temperature range up to 1500° F.

a combination of qualities that can't be beat

***Ask about it!***

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**CAREY Makes The Complete Line** { 85% Magnesia—Industrial Rock Wool / Asbestos—Pipe Coverings—Sheets—Blocks—Batts—Papers—Air Cell

Write for your free copy of "Heat Insulation For Industry." Address your request to Dept. H-7, The Philip Carey Manufacturing Company, Cincinnati 15, Ohio. In Canada: The Philip Carey Company, Ltd., 1557 MacKay Street, Montreal 25, P.Q.

***Because they're years ahead in steam generation . .***

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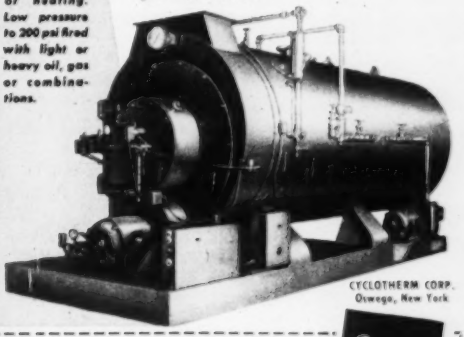
# have cyclonic* combustion POWER

***WHAT IS IT?** It's the modern scientific discovery of transferring heat at the highest degree of efficiency with a new low in fuel consumption. Principal factors of which are the cylinderized solid flame with its exclusive cyclo-motion power, designed to utilize the full potential of every particle of fuel . . . and the thin layer of air resulting from centrifugal force that's always between the flame and wall of combustion chamber. A combination to produce steam far in excess of conventional standards for measured heating surfaces.

**SEND FOR *ALL* THE BIG REASONS**

Learn how the completely automatic Cyclotherm with its unexcelled all-in-one package type features wipe out waste and excess costs. If you are planning a new or replacement boiler installation it will pay you to first get the facts on Cyclotherm. The coupon below is for your convenience.

***SIZES** available to fit your steam or water load for processing or heating. Low pressure to 200 psi fired with light or heavy oil, gas or combinations.*



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Oswego, New York

**CYCLOTHERM CORP.,** OSWEGO, N. Y.

Gentlemen: Please send me bulletin H-1 showing the advantages of Cyclotherm's new concept in Heat Transfer. Without obligation, of course.

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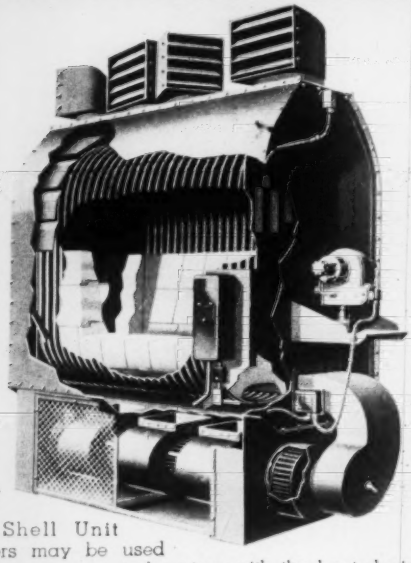
LEE SHELL UNIT HEATER



Lee Shell Unit Heaters may be used singly or as a central system with the heated air distributed through ducts.
The efficiency of Lee Counter-current flow reduces fuel consumption while the rugged simplicity of the system decreases cost of installation, assures low maintenance charges and provides ventilation without additional cost.

The LEE line . . .

LEE ENGINEERING CO.
95 RIVER ST. HOBOKEN, N. J.

**J. R. Vernon, Johnson Service Co.**, Milwaukee, was a featured speaker at the recent three-day institute on automatic controls for oil and gas burners and stokers sponsored by the extension service and the college of engineering of the University of Wisconsin. **P. D. Gayman**, western district manager, and **H. W. Schreiber**, Milwaukee branch manager, were also present to answer questions and demonstrate equipment. As a part of its continuing expansion program, the company has opened 11 new branch offices. The new offices and the engineers in charge are as follows: Birmingham, Ala., appointment pending; Dayton, Ohio, appointment pending; Harrisburg, Pa., **Neal J. McGee**, of the Philadelphia office; Jacksonville, Fla., **John R. Spence**, of the Atlanta office; Knoxville, Tenn., **Trevor D. Reiley**, of the Cincinnati office; Memphis, Tenn., **Edwin A. Smith**, of the St. Louis office; Oklahoma City, Okla., **Andrew H. Scott**, of the Kansas City office; San Antonio, Tex., **Eugene Criss**, of the Cleveland office; Shreveport, La., **Fred A. Dupre**, of the New Orleans office; Syracuse, N. Y., **George C. Kugler**, of the Albany office; Providence, R. I., **John P. Delaney**, of the Boston office.

**Lau Blower Co.**, Dayton, Ohio, has elected **Thomas I. Byrd** as vice president in charge of sales. He has been sales manager since September 1943 and before that was department manager in the market development division of Armco Steel Corp. . . . **Donald W. Pennock**, of Carrier Corp., is the new president of the **American Materials Handling Society**. He is a specialist on the design and installation of all materials handling systems and equipment and devotes the major part of his time to this phase of his company's production expansion program.

**Walter Sturrock** is the newly elected 46th president of the **Illuminating Engineering Society**. He heads the engineering publications section of the lamp department, General Electric Co. . . . **Dr. A. A. Potter**, dean of engineering, Purdue University, is now president of **Bituminous Coal Research, Inc.**, Pittsburgh. He is serving on a part time basis and will continue at Purdue in his present capacity. He assumes the functions of BCR president that have been the responsibility of **R. H. Sherwood** on an interim basis since the resignation of **J. B. Morrow** last April. Mr. Sherwood will again be first vice president.

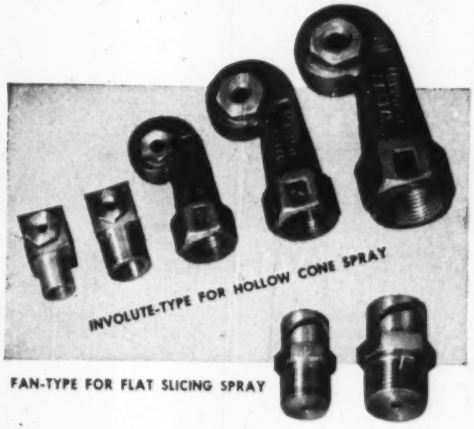
**Air-Maze Corp.**, Cleveland, has named **R. K. Rouse Co.**, 228 N. Main St., Greenville, South Carolina, representative in that state. . . . **Edwin Elliot & Co.**, 560 N. 16th St., Philadelphia, is the new eastern Pennsylvania and southern New Jersey respresentative for **Doyle & Roth Mfg. Co.**, Brooklyn, N. Y. . . . **George Sander** is now in the New York district office of **Penn Electric Switch Co.**, Goshen, Ind. He was formerly with Fluor Corp., Ltd., as a sales engineer and was also with General Electric Co. as a project and service engineer in the appliance and merchandise department.

**Tagliabue Instruments Div., Weston Electrical Instrument Corp.**, Newark, N. J., has appointed the following Weston district sales representatives who are now, in addition, handling the "Tag" line: **C. L. Huffman**, Russell F. Clark Co., Pittsburgh; **C. W. Stafford**, C. B. Fall Co., St. Louis; **E. F. Schimbor**, Herman E. Held, San Francisco; **R. C. Staub**, Beedle Equipment Co., Cincinnati;

for • SPRAYING
• WASHING
• RINSING
• COOLING
• AIR CONDITIONING

YARWAY

# SPRAY NOZZLES




FAN-TYPE FOR FLAT SLICING SPRAY

Get the most out of your Spraying Equipment with minimum power . . . with efficient spraying.

Use Yarway Nozzles. No internal vanes or other restrictions to clog or hinder flow. Two types—Yarway Involute-type producing a fine hollow spray with minimum energy loss, and Yarway Fan-type producing a flat fan-shaped spray with time-saving slicing action for cleaning.

Wide range of standard sizes and capacities. Cast or machined from solid bar stock.

Thousands in use. Write for Bulletin N-616.

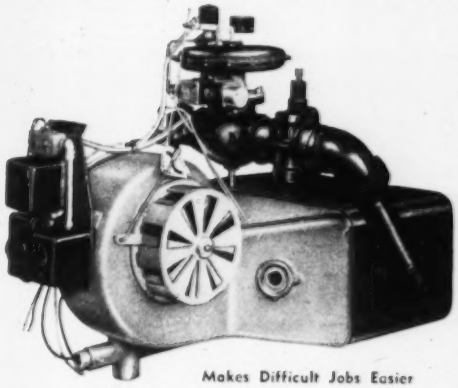
**YARNALL-WARING COMPANY**
107 Mermaid Avenue Philadelphia 18, Pa.

ENTRAINED COMBUSTION

# "FAN-AIR"

MECHANICAL DRAFT AUTOMATIC

## "PACKAGED GAS BURNERS"



Makes Difficult Jobs Easier

The NEW (1950 Model) "FAN-AIR" MECHANICAL DRAFT AUTOMATIC GAS BURNER pictured above, represents the most advanced automatic "packaged" assembly on the market for large commercial & industrial needs. It provides Electric Spark Ignited Safety Pilot with (100%) instant shutoff upon flame failure plus "On & Off" and Modulating Fuel Controls, all factory tested & coordinated prior to shipment.

## Principal Advantages of "FAN-AIR"

- All sizes (5 to 500 H.P.) Fully "Packaged"
- Electric "On & Off" Plus Modulating Fuel Control
- "Spark" Ignited Mettler Rectifier Safety Pilot
- Dependable Electronic Flame Safety Relay
- 100% Instant Fuel Shutoff Upon Flame Failure
- Requires Less Stack & Furnace Draft
- Small Furnace Volume More Effective
- Develops Greater Steam Generation
- No Hot Spots in Furnace Noiseless Combustion
- More Uniform Distribution Improved Turndown Ratio
- Eliminates "Popping & Backfiring"
- Produces Higher Efficiency
- Highest Safety Factor
- Tested & Coordinated Prior to Shipment
- Simplifies & Lowers Installation Costs
- Operates Under Natural Draft Too—When Necessary

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# LEE B. METTLER CO.

NOTE THIS NEW ADDRESS

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**G. O. Miller,** Schiefer Electric Co., Inc., Syracuse; **T. J. Cunerty,** Powerlite Devices, Ltd., Toronto; **A. R. Hough Co.,** Knoxville; **Edward S. Sievers,** Los Angeles; **T. S. Cawthorne Co.,** Detroit; **Eicher & Co.,** Seattle; **Ward Engineering Co., Inc.,** Orlando and Jacksonville; **W. J. Keller,** New Orleans; and, **W. H. Dittman,** Cowperthwait & Brodhead, Boston. In the Colorado territory, **Peterson Co.,** Denver, handles sales of chemical and industrial thermometers, hydrometers and moisture meters, while **Burson Sales, Inc.,** also of Denver, handles pyrometers and the mechanical line of instruments and thermometers.

**Zechariah Chafee,** chairman of the board, Builders Iron Foundry and its subsidiaries, Builders-Providence, Inc., Proportioneers, Inc., and Omega Machine Co., was recently named to one of the University Professorships of **Harvard University.** These Professorships, of which there have been only four until now, are so called because the holders are not restricted in their interest to any particular department or field of knowledge. . . . **Hess, Greiner and Polland,** Los Angeles, are now exclusive distributors in southern California for **Utility Appliance Corp.,** Los Angeles. Heavy duty blowers will be handled.

**Peter A. Anderson,** president of Utilities Distributors, Inc., has been elected president of the **Liquefied Petroleum Gas Association,** succeeding **S. G. Darling,** president, Darlingas, Inc. Other officers for 1950-51 include **William S. Lander,** Rulane Gas Co.—first vice president; **F. N. Mabee,** Colorado Natural Gas & Fuel Co.—second vice president; **Walter Miller,** Dri-Gas Corp.—treasurer; and **Arthur C. Kreutzer,** Chicago—secretary. **Howard D. White,** former executive vice president of the association has returned to the organization in the same capacity. Since October of last year he has been identified with Perlite Development Corp. Mr. Kreutzer, managing director of the association during Mr. White's absence, has also been named vice president and general counsel.

Several new promotions to the field sales force, as well as changes within its service organization have been made by **Black & Decker Mfg. Co.,** Towson, Md. **Robert A. Brown,** service engineer at the Cincinnati factory service station, has been promoted to sales engineer in the Atlanta branch territory. **George H. Thalman, Jr.** succeeds Mr. Brown and **William F. Dunn, Jr.,** formerly service engineer at the New Orleans branch, has been promoted to sales engineer in this territory. **Grady R. Funk,** service engineer at Charlotte, has taken over Mr. Dunn's former position. **Robert Dawson** is now a sales engineer covering the Nebraska and western South Dakota region.

**Eutectic Welding Alloys Corp.,** New York, has made a number of field force promotions headed by the appointment of **Don Rasmussen** as western sales supervisor. Other advances are: **Herman Greif** and **Daniel Wetmore** to regional managers; **Hugh Hurley** and **Roy Waldrop** to assistant regional managers; **Don Garrett, Lee Wade,** and **Alex Frederick** to district managers. These men will supervise the activities of district engineers in their various areas.


9 out of 10 New Homes Heat with OIL or GAS

You Sell BOTH Markets with ALDRICH HEAT-PAK BOILER-BURNERS

Burners Interchangeable

Expand your market to 90% of new home construction with Aldrich. Sell more, with less inventory . . . cash in with oil units, cash in again with gas burners.

Mounting plates are similar; installation is fast and simple. And you can convert from one fuel to another without changing boiler set-up or performance.

7 makes 14

Aldrich Heat-Pak boilers come in 7 sizes, from 100,000 to 808,000 BTU/hr. With both oil and gas, you have 14 compact heating plants to sell everything from modern small homes to big commercial installations. Vertical-type, compact and efficient; shipped crated fully assembled, ready to set in place and connect.

Profit with ALDRICH—Get Details Today. Write or wire for Heat-Pak facts, full specifications.

ALDRICH HEAT-PAK PRODUCTS

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105 East Williams Street, Wyoming, Ill.

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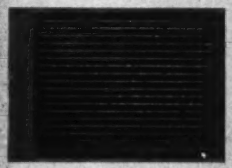
ANOTHER BREEZE MARK PRODUCT

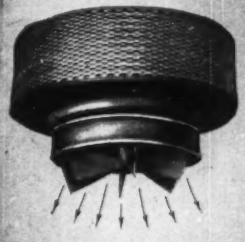
# McCORD
## HEATING AND AIR CONDITIONING PRODUCTS

### BLAST HEATING COILS—AIR CONDITIONING COILS—ALL TYPES



All copper spiral fin tube construction with the tubes formed or bent permits uniform expansion without strain. Headers are heavy wall construction with tubes brazed into extended ferrules formed in the headers. Fins are helically wound and metallically bonded. May we send catalog?

### VERTICAL TYPE UNIT HEATERS



A proven heating unit, modern in design, incorporating every unit heater advancement. McCord copper spiral fin tube construction creates air turbulence without undue restriction. Improved fan blades deliver large volume of air with minimum air noise. Guaranteed for 150 lbs. saturated steam pressure. Specify McCord.

### HORIZONTAL TYPE UNIT HEATERS

A time proven heating unit, modern streamlined in design, quiet, yet its rugged construction adapts it to all types of installations, guaranteed for use on No. 150 p. s. i. steam pressure. All copper heating element, individual spiral fin tubes free to expand without strain on joints. Standard motors with standard bases used. Wide range of capacities.

Save fuel with McCord Unit Heaters.

McCord CORPORATION
DETROIT 11, MICH.



## THE LOWDOWN ON INSULATION

## Cold can travel safe and dry

Whenever you produce cold in one place and use it in another, you have a special transportation problem.

Refrigeration costs money to produce. It can be dissipated fast. You want to save as much as possible. Also, the pipes or ducts in which you carry the cold will drip with condensed water if their outside surfaces get cold.

The answer, of course, is good insulation, such as Novoid Cork Insulation. But that's not the whole answer. The installation must be right, too. Over the years, we have built up an experienced, trustworthy group of distributors and contractors who install Novoid Insulation so it will give maximum service. It pays to call one of them on your next job. Write and ask us which one is nearest you. Novoid Cork, Englewood, N. J.

**Consider EVERY factor when you buy insulation—and you'll buy NOVOID**

### Check list of insulation properties

| | Novoid Cork Insulation | Many Other Insulations |
|---|---|---|
| First cost | moderate | low to high |
| Installation cost | low | moderate to expensive |
| Eventual cost | low | high |
| Efficiency | remains high | generally deteriorates |
| Moisture resistance | excellent | some good; some poor |
| Vapor seal | simple | complicated or diffi. cult to install |
| Structural strength | very good | some non-existent; others fair |
| Weight | very light | varies |
| Resilience | considerable | from fair to complete rigidity |
| Settling | none | a serious problem |
| Supporting structure | none | elaborate |
| Fire resistance | good | excellent to poor |
| Vermin resistance | good | excellent to very bad |
| Odor absorption | none | some are regular sponges |

# NEW BOOKS & REPORTS

### New Edition of Kent's Handbook Almost Completely Rewritten

Kent's Mechanical Engineers' Handbook, first published in 1895, has, in its 11 editions, become a standard handbook of the profession. Expansion of the science of engineering made it necessary to divide the handbook into two parts for the first time in the 11th edition.

For this, the twelfth edition, the Power Volume has been entirely rewritten, from cover to cover, excepting a few passages that have been reviewed by various authorities and retained because of their value. The broad purpose of the Power Volume is to cover the entire field of heat-power engineering and transportation as well as the important aspects of fluid flow. It has been organized in groups of sections and the basic ingredients of any power process (air, fuel, heat, and steam) are covered in the first four sections. The service functions, pumping and piping, are covered in two sections and power-producing equipment (boilers, turbines, condensers, and gas turbines) are covered in four sections. Sections 11 and 12 are devoted to refrigeration, heating, ventilating, and air conditioning. Transportation is covered in three sections and electric power is the subject of Section 16. Atomic energy, instrumentation, power test codes, and mathematical tables are the subjects of the last four sections.

Space given in the previous edition to steam engines, gas producers, and other less active subjects has, in this edition, been devoted to the more modern and less widely understood subjects such as atomic power, combustion gas turbines, supersonics, marine engineering, jet propulsion, heat pumps, panel heating, diesel locomotives, axial flow compressors, and instrumentation.

The Design and Production Volume is directed primarily to engineers who design and manufacture machinery, appliances, mechanical equipment, and other engineered products. The 28 sections into which the book has been rearranged may be classified broadly as selection of materials, design principles, design and selection of machine components, production processes, production plant equipment, and mathematical tables. The presentation of each subject attempts to give the engineer a quick grasp of the essentials of the field, together with pertinent technical data in condensed form. With minor exceptions, this volume has been almost completely rewritten.

Both volumes are published by John Wiley and Sons, Inc., 440 Fourth Ave., New York 16, and each is priced at $8.50. Each volume contains over 300 ($5\frac{1}{2} \times 8\frac{1}{2}$ in.) pages and is clothbound.

### Develops Equations for Determining Optimum Tube Size for Heat Exchangers

The total annual cost for a shell and tube type heat exchanger, which is the sum of the annual power cost plus the fixed charges or annual amortization of the initial cost of the equipment, is found to vary sharply with small changes in tube size when the heat transfer rate is held constant, according to F. D. Cardwell, research engineer, Chemical Construction Corp. In his paper Optimum Tube Size for Shell and Tube Type Heat Exchangers, equations are developed reducing the number of assumptions to length of tubes and diameter of tubes for fixed design

Seattle's New
*Nettleton Apartments*
—Equipped with Dependable
ENTERPRISE BURNERS

Completely modern throughout, the 14-story Nettleton twin-building apartments rely on two Full Automatic Enterprise Oil Burners for year-round heating and hot water requirements. Thoroughly efficient and dependable, quality Enterprise Burners are providing money-saving, trouble-free service to thousands of buildings of every type throughout the world. For the finest in oil and combination oil-gas burners, specify Enterprise—the choice of heating experts.

One of the two Enterprise Burners at the Nettleton Apts. Size J2-P, full automatic, modulating control.

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*Consulting Engineer:* E. L. Weber
*General Contractor:* Nettleton-Baldwin-Anderson, Inc.
*Mechanical Contractor:* University Plumbing & Heating Co.

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Enterprise Oil Burners

**. . . push pipe under streets, lawns, floors, walks with a**

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Cut costs, save time on underground pipe installations this fast, easy way.

With a GREENLEE Hydraulic Pipe Pusher *one man* can push pipe through the ground and under obstructions.

Saves the time, hard work, and inconvenience to all caused by the old methods of tearing up lawns, floors, and pavement. Eliminates tedious digging, tunneling, back-filling, tamping, re-paving, as just a short trench accommodates the pusher.

Save with the GREENLEE Pipe Pusher, which often pays for itself on the first few jobs. Learn all about this compact, portable, powerful pipe installing equipment. Write for details today. Greenlee Tool Co., Division of Greenlee Bros. & Co., 2347 Twelfth St., Rockford, Ill.

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## AGAINST CORROSIVE FLUIDS

## Fairbanks®
### all iron gate valves

. . . are made of high-test alloy iron to withstand the action of many of the strongest chemicals such as concentrated sulfuric acid, alkalies, aniline oils, sodium and potassium cyanides and creosote. These iron body valves give long service under the severe operating conditions that exist with use of these destructive agents.

Fairbanks All Iron Gate Valves—like those in all Fairbanks lines—are low in maintenance cost, easy to operate and long-lasting in service . . . a real answer to cost-cutting needs today.

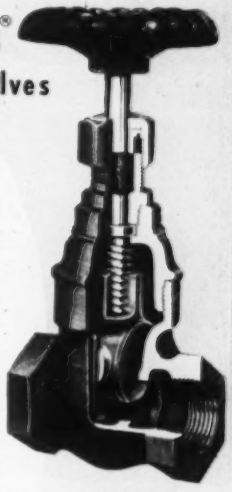

Fig. 0318
ALL IRON GATE VALVE
150# SWP 225# WOG
Non-Rising Stem • Solid Wedge • Taper Seat
½"-2" Sizes

Fig. 0904
ALL IRON GATE VALVE
125# SWP 200# WOG
Solid Wedge • Taper Seat • Malleable Iron Seat Rings
2"-12" Sizes

Fig. 0418
IRON BODY U-BOLT GATE VALVE
150# SWP 225# WOG
Bronze Mounted • All Iron Rising Stem • Solid Wedge • Taper Seat
½"-4" Sizes

For handling other types of corrosive fluids such as dry carbon dioxide, ethyl acetate, malt beverages, propane and butane gas use FAIRBANKS BRONZE SOLDER END and FAIRCO-BRAZE (silver-brazed) VALVES.

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Register and Grille Mfg. Co., Inc. has 45 Representatives conveniently located in Principle Cities

No matter whether your project calls for a Standard Model or one built to Your Specifications, these men, and our highly trained Engineering Staff, stand ready to give you information about the some 100 different designs we make. If you don't know his name and address, we will be glad to furnish same.

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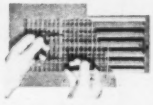
PRESIDENT.

**14 MODELS RECENTLY STANDARDIZED FOR AIR CONDITIONING**

Pictured is the Supply Register, Style 420 featuring adjustable Horizontal and Vertical Deflection with Volume Control Shutter.



Write for our Catalog with over 150 illustrations showing the complete R & G line of Air Conditioning Registers and Grilles and Architectural Perforated Grilles.

This Coat of Arms stands for Highest Standards of Service and Quality, Skill and Integrity of the Artisans of this Company and over Two Hundred Years of combined Executive "know how."

**REGISTER & GRILLE MFG. CO., INC.**

70 BERRY STREET, BROOKLYN 11, N. Y.


conditions, such as total flow rates in the shell and tube and required heat transfer rate.

For a selected length as a parameter, the total annual cost is calculated for each tube diameter. The optimum tube diameter is determined from a graph of these corresponding values which has a well defined minimum value for the total annual cost. A family of these curves, each having a different length as the parameter, will each have a minimum and these minimal values will all be nearly equal, according to the author. Another family of curves with standard tube diameter as the parameter will each have a minimum giving the optimum length for each diameter. Therefore, only one convenient parameter need be selected from which the optimum combination can be determined from a curve. Since the required heat transfer surface area is now determined, the number of tubes for this combination follows automatically.

Presented at the recent spring meeting of the American Society of Mechanical Engineers this paper (No. 50-S-6) has been reprinted and copies may be obtained from ASME headquarters, 29 W. 39th St., New York 18.

### Solar House Requires Only 10 Percent Auxiliary Heat

The first complete report on operation of the MIT solar heated house will be presented to members of a course-symposium on space heating with solar energy at the Massachusetts Institute of Technology next month. The full report provides a basis for predicting that "a 10 percent-auxiliary-fuel-burning house is possible without ultra-high construction cost" in the Boston area.

Tentative figures released by the MIT solar energy conversion committee show that during the last three months of the 1948-49 heating season, the flat-plate collector on the MIT solar-heated house absorbed slightly over 30 percent of the total incident energy. The maximum collected in one hour during this three-month period was 63 percent of the total energy then striking the unit.

Slightly more than 50 percent of the total heat requirement of the house was met by the solar-energy roof collector during this three-month period. An additional 30 percent came from large double-and triple-glass windows in the south wall of the house, which were covered by special insulating curtains after dark.

Auxiliary heating units, provided to maintain comfortable temperatures when sufficient solar energy was not available, were called on for only about 10 percent of the house heating requirements, the balance of heat required coming from appliances and other miscellaneous sources.

Though the report shows that 30 percent of the house heat requirement was fulfilled by the south windows of the MIT house, members of the committee state that this is a heat source of limited practicality, since large windows are often inefficient because they cause overheating during sunny periods and excessive heat losses during sunless periods.

A house of this design, according to the preliminary calculations of the committee, could probably be heated efficiently with solar energy in a climate with an average winter temperature about 10 deg warmer than Boston's 40 F, but such a house would still need some auxiliary equipment to carry over long periods of cloudiness and occasional extreme cold snaps.

# hot water in a hurry!

Where sudden hot water pulls—or an unpredictable time schedule—are in the order of things, install

# Paracoil INSTANTANEOUS WATER HEATERS

TO KEEP PACE WITH THE LOAD—ALL THE WAY!

No storage tank is necessary—they have enough, and more, heating surface built into them to heat the water as fast as it is drawn! Thousands in use.

*If you have such a probleem, we have the answer! Stock designs permit quick deliveries at prices lower than you think!*

Write today for a copy of our new Bulletin 70 Section I, describing this line of Paracoil Water Heaters.

This bulletin, in addition to tables of capacities and physical dimensions on our U-Tube designs, contains a wealth of practical, worthwhile engineering data on how to size, figure steam requirements, and pipe up PARACOIL INSTANTANEOUS WATER HEATERS. YOUR COPY AWAITS YOU!

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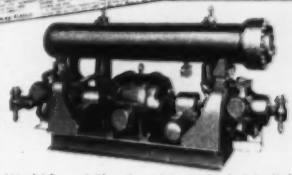
30 Rockefeller Plaza, NEW YORK 20, NEW YORK

AGENTS IN PRINCIPAL CITIES



NEWS FLASH FROM NEW ORLEANS

671-TON COOLING SYSTEM INSTALLED IN NEWSPAPER OFFICES



World-famed Chrysler Airtemp Sealed Radial Compressor. Ten of these Central System units and seven "Packaged" Air Conditioners cool the 6-story Times-Picayune Building.

Another distinguished name—that of the New Orleans *Times-Picayune*—has been added to the growing roster of modern buildings air conditioned by Chrysler Airtemp. When the decision was made to air condition this newspaper plant — Chrysler Airtemp was, naturally, the logical choice.

For Chrysler Airtemp—builder of THREE basic systems—was the one firm which could provide the IDEAL installation for this complex operation. To supply adequate cooling for the entire building—in the face of widely varied heat loads of the many departments vital to a newspaper—it was necessary to install 17 different cooling units—ranging from 75-ton Radial Compressors to compact 3-ton "Packaged" Air Conditioners.

Chrysler Airtemp's specialized knowledge and experience in solving difficult problems are available to you at all times. Through regional offices and dealers in principal cities—Chrysler Airtemp offers the services of trained engineers to assist Architects, Builders and Contractors in selecting and installing the RIGHT system for each job. When desired—Airtemp Construction Corporation, subsidiary of Chrysler Corporation, will assume entire responsibility for all or any part of your air conditioning projects—from specification to final inspection.

Let us send you the complete story of Chrysler Airtemp's services and products. It should prove a big help to you. Just fill out the coupon and mail it today.

Chrysler Airtemp

AIR CONDITIONING • HEATING • COMMERCIAL REFRIGERATION

3 BASIC SYSTEMS to Meet Every Air Conditioning Need

AIRTEMP DIVISION OF CHRYSLER CORPORATION, Dayton 1, Ohio

Gentlemen: Please send me details about Chrysler Airtemp's engineering services for planning and installing air conditioning systems.

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## Describes Methods of Measuring Skin Temperatures

Radiation exchange between human skin and the environment obeys the same physical laws applicable to inanimate objects. However, living subjects possess the ability to shunt blood from deep to superficial areas so as to alter skin temperature. Accurate measurements of skin temperature are important in determining heat exchange with the environment. They are also useful in evaluating thermal insulation properties of clothing in the range of environmental temperatures producing a sensation of comfort.

In a paper, Man and Thermal Radiation, by Lawrence R. Prouty, M. D., Cornell University Medical College, it is pointed out that no really accurate method of measuring human surface temperature existed until 1934 when a radiometer was developed by J. D. Hardy for this purpose. After describing this dermal radiometer, Dr. Prouty points out that it is inadequate for measuring mean radiation exchange between man and his out-of-door surroundings as it can "see" only one small area of skin surface or environment at a time. An instrument called the pan-radiometer has been developed by Hardy and Richards to "see" the entire environment approximately as the human skin "sees" it. Dr. Prouty briefly describes the use of this instrument and states a number of conclusions which may be made from preliminary experiments with the device. In his opinion, the results of these studies in human radiation exchange, when given practical application, should greatly increase the comfort of working and living spaces. Many older concepts of heating and air conditioning by control of room air and humidity alone are certain to be replaced, according to Dr. Prouty.

The paper is contained in the December, 1949 issue of Research Reviews, published by the office of Naval Research, Department of the Navy, Washington, D. C. Unfortunately, copies of this issue are not available for general distribution.

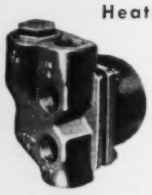
## Other Books and Reports Received

**Cast Brass Solder-Joint Fittings** (B16.18-1950)—A new standard released by the American Standards Association, 70 E. 45th St., New York 17. It covers pressure ratings, abbreviations for end connections, sizes and method of designating openings of reducing fittings, marking, minimum requirements for material, dimensions and tolerances, and tests. It does not cover drainage fittings for which a separate standard is being developed, and it replaces ASA Standard A40.3-1941. Single copies are available at 75 cents either from ASA headquarters or from the American Society of Mechanical Engineers, 29 W. 39th St., New York 18.

**Graphical Symbols for Heat-Power Apparatus** (American Standard Z32.2.6-1950)—This ASA standard is a revision and expansion of the heat-power symbols published in the 1941 standard on graphical symbols for use on drawings in mechanical engineering. The list includes 44 symbols having national acceptance and the standard has been recently published by the American Society of Mechanical Engineers, 29 W. 39th St., New York 18.


# Sterlco Heating and Temperature Control Products

### Heating Specialties



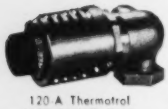
¾" 69-B Float and Thermostatic Trap.

**Thermostatic Traps:** ½" to 1" sizes; low, medium, high pressure; wide variety of body styles.

**Float and Thermostatic Traps:** ¾" to 2" sizes; low and high pressure.

**Strainers:** ⅜" to 2" sizes; cast iron or brass bodies. Also *Radiator Valves, Vents, Boiler Return Traps.*

### Temperature Control Valves



120-A Thermotrol Individual Radiator Temperature Control.

**No. 120 Thermotrol:** Self-contained individual radiator temperature control for steam or hot water. Easily installed in place of manual radiator valve. Sizes ½" to 1"; all body styles.

**Tank Temperature Controls:** Self-powered modulating control valves for fluid heaters and all types of process equipment for heating or cooling. Sizes ⅜" to 2".

### Condensation and Vacuum Pumps

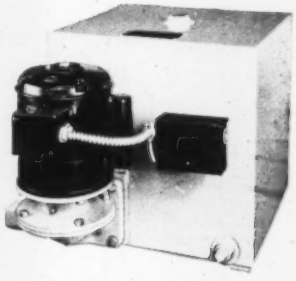
**4100 Series:** Compact, economical condensation pumps with 15 or 30 gallon steel tank, dual voltage capacitor type motor, rotary seal, and simple, sturdy vertical centrifugal pump. For all low pressure jobs up to 14,000 sq. ft. E.D.R. and 20 lbs. pressure.

**4200 Series:** Same as 4100 Series except cast iron tanks.

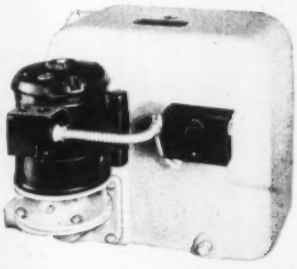
**3500 Series:** Heavy duty condensation pumps with pedestal mounted steel tank, for a wide range of jobs — 2000 to 65,000 sq. ft., up to 150 lbs. pressure.

**3700 Series:** Condensation pumps with heavy cast iron tank for installation underground or in wet locations, 2,000 to 20,000 sq. ft., 20 or 30 lbs. pressure.

**Vacuum Pumps:** Type V, 2500 and 5000 sq. ft., 20 lbs. pressure. Type S, 10,000 to 40,000 sq. ft., 20 to 40 lbs. pressure.



4126-B Condensation Pump (Steel Tank)



4226-B Condensation Pump (Cast Iron Tank)

*Descriptive bulletins with complete specifications of any of the above products will be furnished promptly upon request.*

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***Sales Representatives in Principal Cities***

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EXPANSION JOINTS

The largest operating Utility in New England

"D-F S-E Joints installed in early thirties are still on the job"

Back in the early thirties the now-famous Badger Directed-Flexing principle was added to the Self-Equalizing construction. The principle underlying the idea (see illustration below) looked sound to the Utility Engineers and several joints were ordered and installed in their central heating distribution system. Badger D-F S-E Joints are still on the job.

With this Utility, as with hundreds of others, Badger Directed-Flexing Self-Equalizing Expansion Joints are famous for performance. Reasons? *Exclusive* construction features which guarantee longer life without maintenance. So be wise, figure in terms of costs and specify Badger Joints. Send for your copy of new 24-page catalog.

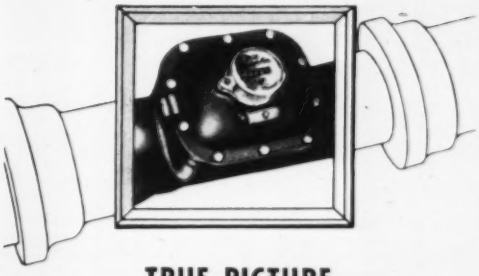
Badger Joints flex like this . . .
not like this . . .
All-curve flexing guarantees longer life
EXCLUSIVE construction of Badger Joints eliminates localized flexing stresses that cause breakdowns. Directed Flexing Equalizing Rings control and contain movement to all-curve pattern — distribute stresses to all parts of flexing member.
COLD
HEATED

**Badger**

MANUFACTURING COMPANY

230-260 BENT STREET CAMBRIDGE 41, MASS.





## TRUE PICTURE OF WATER CONSUMPTION

**BUILDERS PROPELOFLO METER** gives you a true picture of actual flow through your main and auxiliary pipelines. This self-contained and self-operated propeller-type meter registers accurately and dependably each gallon or cubic foot as it passes the meter. It gives the information you need to check water costs — to stop water waste — to maintain your boilers, condensers, and air conditioning systems at top operating efficiency.

***Some important Propeloflo features:***

- **High accuracy over wide range of flow**
- **"Venturi design" — Low loss of head**
- **Self-contained and Self-operated**
- **For pipelines 2" and larger — Reads direct**
- **Quality construction — Quality materials**
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For Bulletins and engineering information, address Builders-Providence, Inc. (Division of Builders Iron Foundry), 381 Harris Avenue, Providence 1, Rhode Island.

. . . . . .

Builders makes a complete line of flow meters and controllers for liquids, steam, air, gas, and dry materials . . . mechanical and differential . . . including The Venturi Meter and Chlorinizers (chlorine gas feeders).

**BUILDERS PROVIDENCE** *Instruments*

AVERAGES 10% LESS
IN
OPERATING
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LO-BLAST

POWER-TYPE
GAS CONVERSION BURNER

An utterly different kind of burner—proved in 18 years of actual operation to slash fuel and service costs! A Lo-BLAST dealership is the sure way to make money—fast! Write today for information.

8 BIG REASONS WHY

1. Power burner combustion—independent of variable natural draft within the furnace—perfectly controlled primary and secondary air at all times.
2. Combustion completed in incandescent fire box—radiant heat applied to crown sheet as well as side walls.
3. Soft, quiet flame—no combustion roar.
4. Standard controls with positive acting pilot and blower safetys.
5. Foolproof design prevents shut-downs and service costs.
6. Package job, factory tested on gas, shipped completely assembled. Simple to install.
7. Nothing in the fire box but the fire.
8. Attractively priced for competitive selling.

THE ECONOMITE
Residential size burner with all the famous design features of Lo-BLAST Burners.

MID-CONTINENT
METAL PRODUCTS CO.
1960 N. Clybourn Ave., Chicago 14, Ill.

**Proceedings of the First National Air Pollution Symposium**, November 10 and 11, 1949, Pasadena, Calif., sponsored by Stanford Research Institute in cooperation with the California Institute of Technology, the University of California and the University of Southern California—Some 21 technical papers were given at the symposium and are included in the proceedings. Topics covered include the preparation, collection, and measurement of aerosols; the determination of concentration and size of particulate matter; national trends in air pollution; sampling of industrial stacks and effluents for atmospheric pollution control; instrumentation problems in the analysis of the atmosphere; the economics of air pollution; and atmospheric pollution caused by the diffusion of waste industrial gases. The proceedings contains 149 pages, is priced at $2.50, and may be obtained from the Stanford Research Institute, Stanford, Calif. Also available from the Institute for $2.00 is the proceedings of the Second Annual Northern California Research Conference.

**Fly Ash Collection for Small Plants by** A. A. Petersen, chief engineer, Prat-Daniel Corp., East Port Chester, Conn.—This paper was prepared to alert and inform small plant owners and management burning coal and having fly ash problems, as a result of more stringent legislation and dust codes. According to the author, the trend indicates, in many cases, that previously accepted methods of controlling fly ash emission may no longer prove adequate. A review of various types of dust collectors, covering the advantages and disadvantages of each relative to dust ordinances, is given. The paper was presented at the recent spring meeting of the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, and is identified as paper No. 50-S-31.

**The Airflow Slide Rule**, by Lisbeth Crowell, research engineer, aeronautics section, The Franklin Institute—The functions relating supersonic airflow properties appear to be so formidable that few people bother to make numerical calculations. This paper describes a slide rule which was developed by the author to meet the need for an automatic computing device and to afford an easy, accurate and rapid means of determining transonic and supersonic airflow relations. Properties or characteristics involved include temperature, velocity, pressure, density, and the Mach number. The paper describes the slide rule and gives examples of its use. Copies may be obtained from the Franklin Institute of the State of Pennsylvania, Philadelphia 3.

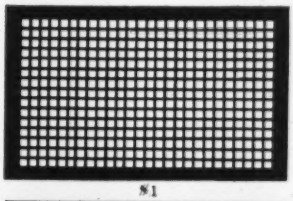
**Directory of National Trade Associations and Organizations in the Heating Equipment, Fuels, and Related Industries**, compiled by the Stoker Manufacturers Association, 307 N. Michigan Ave., Chicago 1 and priced at 25 cents per copy—A new second edition of this directory is now available in mimeographed form. The directory is separated into the following categories: heating equipment manufacturers; industrial and commercial equipment manufacturers and other miscellaneous groups; heating wholesalers, distributors and contractors; heating accessories, auxiliary equipment, fittings and parts manufacturers; associations of fuel producers, distributors, etc.; and professional and engineering societies and organizations.

# *For Every Requirement...*

A-J REGISTERS and GRILLES

A-J offers a complete line for the largest to the smallest jobs—you can install them with full assurance of the best possible quality and performance. A-J Registers and Grilles are made to *last* and designed to harmonize perfectly with any architectural styling.

*The A-J Line will be a valuable adjunct to your planning programs. Write us for more complete details.*



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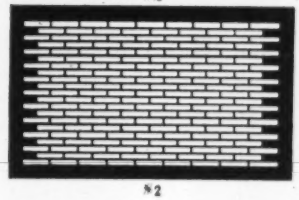


#2

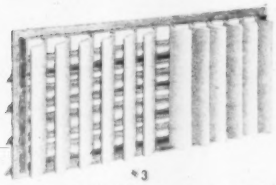
Here are several illustrations to help show the variety of the A-J line.

#1—Plain Lattice Design with 53% area. Especially popular for ventilating systems.

#2—Slotted Design—73 to 75% free area. Particularly suited to tasteful architectural motifs.

#3—Double Diffusers. Ideal for jobs where large volumes of air must be controlled. Also available as single diffusers where horizontal deflection is not required.

#4—#700 Series No-Vision Door and Partition Grilles. Available with channel or flange frame. The 700 A-B grilles offer maximum free area yet are completely sight proof.



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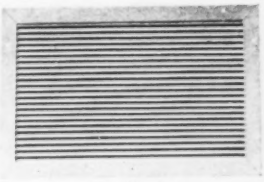

#4

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## A-J MANUFACTURING CO.

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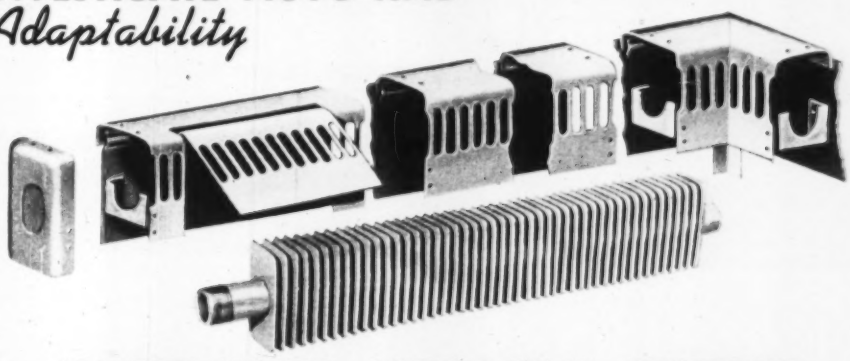

## ADAPTABLE TO ANY ROOM CONTOUR

**AUTO-RAD BASEBOARD CONVECTORS are easily adapted to any shape room by simple installation methods. Investigate AUTO-RAD for your next installation. You will find them labor saving and profitable.**

**Photo shows AUTO-RAD enclosure accessories; ends, weighted door, front grill, rear enclosure, hangers, inside corner, etc. with matched punched holes, resulting in continuity of design.**

AUTO-RAD Inc.

WRITE FOR BULLETIN No. 50

Manufacturers of Heat Transfer Equipment Since 1920

3535 Fillmore Street, Chicago 24, Ill.

# MEETINGS & CONVENTIONS

**First United States International Trade Fair**—To be held August 7 to 20, Chicago. Exhibits will be classified under 29 categories, including both industrial and consumer commodities, and will include displays of heating, ventilating, and air conditioning equipment. Fair headquarters is in the Merchandise Mart, Chicago 54.

**National Power Show,** sponsored by the National Association of Power Engineers, 176 W. Adams St., Chicago—The 49th annual show and the 67th annual convention of the association will be held August 15 through 19, Hotel Jefferson, St. Louis.

**Sixth National Chemical Exposition,** sponsored by the Chicago section of the American Chemical Society, 86 E. Randolph St., Chicago 1—To be held September 5 to 9, Chicago Coliseum. The show will be held concurrently with the national meeting of the American Chemical Society.

**Instrument Conference and Exhibit**—Sponsored by the Instrument Society of America, 921 Ridge Ave., Pittsburgh 12, the 1950 Instrument Conference and Exhibit will be held in the War Memorial Auditorium, Buffalo, N. Y., from September 18 to 22. This will be the fifth national conference and exhibit of the Society.

The 1951 conference and exhibit will be held September 10 to 14, at the Coliseum, Houston, Tex.

**American Society of Mechanical Engineers,** 29 W. 39th St., New York City—The fall meeting is scheduled for September 19 to 21, Hotel Sheraton, Worcester, Mass., and the annual meeting will be held November 26 to December 1, Hotel Statler, New York City.

**American Gas Association,** 420 Lexington Ave., New York 17—The 1950 annual convention will be held October 2 to 6, Atlantic City. Haddon Hall has been designated as headquarters for the accounting section; the Ritz Carlton hotel will be headquarters for the residential gas section and the industrial and commercial section; and the Dennis hotel will be headquarters for the operating section.

**Refrigeration and Air Conditioning Conference and Exhibit,** sponsored jointly by the Refrigeration Equipment Manufacturers Association and the Refrigeration Service Engineers Society—The remaining three conferences in a series of four will be held November 17 to 19, Municipal Auditorium, Long Beach, Calif.; January 26 to 28, State Fair Grounds, Dallas; April 6 to 8, Hotel Statler, Buffalo.

Additional information may be obtained from the REMA public relations department, 1346 Connecticut Ave., N.W., Washington 6, D. C.

**Refrigeration Service Engineers Society,** 433 N. Waller Ave., Chicago—The 13th annual meeting, November 17 through 19, Long Beach, Calif.


*Simplify* **fastening insulation to metal ductwork with LEXSUCO INSULATION CLIPS**

SIMPLE — Just insert the clip in the insulation and with the sharp blow of a hammer, it locks itself to the metal duct. The shoulder prevents penetration beyond insulation thickness.

SPEEDY — This easy "hammer and nail" method provides very fast application.

LABOR-SAVING — No preparation of the surface; no special tools or completing materials needed

SIZES — Available for 1/2", 13/16" and 1" thick insulation.

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FASTENING SYSTEM

FOUR MINUTES per fastening (total time on job) with RAMSET SYSTEM instead of NINETEEN MINUTES with his old method saved this contractor $2,841.00 on one steel fastening job. Instead of slow, laborious, costly drilling—just load the self-powered, light, RAMSET FASTENING TOOL. Then —READY! RAM! SET! Quick, easy, economical —and tight. *Actual fastening time, less than one minute per fastener!*

Compare *your* fastening costs into steel, concrete and other hard materials. See how much time and money you can save with the simple, lightning-fast RAMSET SYSTEM. With 65 sizes and types of drive pins and threaded studs, you can do almost any kind of construction fastening job.

Your local RAMSET Specialist will help you cut costs and show you how to "RAMSET" your way into more profitable business. Write or wire us collect for name of nearest representative.

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## *Ramset System*

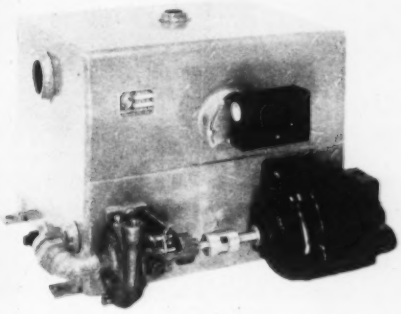
**SAVES TIME . . . CUTS COSTS ON JOBS LIKE THESE:**

*Installing*

- Pipe hangers.
- Sprinkler systems.
- Duct work.
- Metal radiator reflectors.
- Sheet metal work.
- Refrigeration lines.
- Electrical controls.

# *ANNOUNCING—*

# EAGAN "EAGLE" CONDENSATE PUMP



**MATCH THIS FOR VALUE!**

Here's the best condensate pump "buy" on today's market. It provides far more capacity than any similar pump . . . 8,000 sq. ft. EDR at 20 PSI . . . and it's only **$119.00** (trade price).

## Compare These Six Features

Mail coupon for full details

- √ **Low inlet, 2" IPS, 12" from floor**
- √ **All bronze centrifugal pump**
- √ **Flexible coupling**
- √ **Standard ¼ HP capacitor motor**
- √ **Thermal overload protection**
- √ **Level indicating 2 pole float switch**

## WALTER H. EAGAN CO., INC.

Mfgs. of Condensate, Vacuum, Turbine, Boiler Feed and Centrifugal Pumps.

Pump Specialists since 1920

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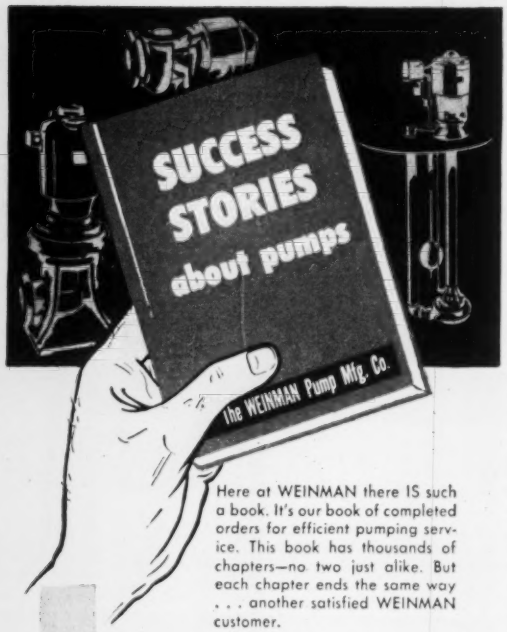
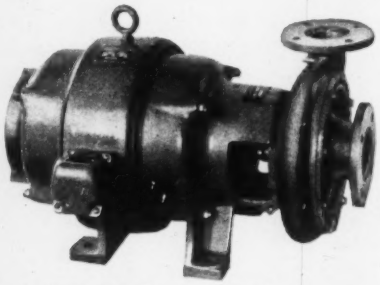



Here at WEINMAN there IS such a book. It's our book of completed orders for efficient pumping service. This book has thousands of chapters—no two just alike. But each chapter ends the same way . . . another satisfied WEINMAN customer.

If you have the responsibility for efficient liquid handling at your plant, it will pay you to consult a WEINMAN representative. He will help you work out any pumping problem—application—installation—or replacement. Your problems can then be solved and another "success story" will be added to our book.

For a non-obligating consultation, just write, wire or phone WEINMAN Career Men in Pumps.



Weinman General Service UNIPUMP handles up to 1000 G.P.M., heads to 500 feet.

Representatives in Principal Cities.

*Built by Centrifugal Specialists*

**The WEINMAN Pump Mfg. Co.**

284 Spruce Street • Columbus 8 • Ohio

**19th National Exposition of Power and Mechanical Engineering,** November 27 to December 2, Grand Central Palace, New York City—The show will be held in conjunction with the annual meeting of the American Society of Mechanical Engineers and, for the first time, will be under the auspices of the society. Show management is being handled by International Exposition Co., Grand Central Palace, New York.

**National Warm Air Heating and Air Conditioning Association,** 145 Public Square, Cleveland 14—The 37th annual convention, December 5 and 6, Hotel Statler, St. Louis.

**American Society of Heating and Ventilating Engineers,** 51 Madison Ave., New York 10—The 1951 annual meeting will be held in Philadelphia, January 22 to 25. Registration and technical sessions will be at the Bellevue-Stratford hotel, other meeting functions at the Benjamin Franklin and Warwick hotels.

**10th International Heating, Ventilating and Air Conditioning Exposition**—Under the auspices of the American Society of Heating and Ventilating Engineers, the show will be held January 22 to 26, Commercial Museum, Philadelphia. International Exposition Co., Grand Central Palace, New York City, is managing the affair.

**American Society for Testing Materials,** 1916 Race St., Philadelphia 3—The 1951 annual meeting is scheduled for June 18 to 21, Atlantic City, and the 1952 annual meeting will be held June 22 to 27, New York City.

---

## Analyzes Properties of Thin-Walled Curved Tubes of Short Bend Radius

Different flexibility and stress-concentration factors exist for each type of applied load and for each type of deflection of thin-walled tube bends having end constraints and having moments varying along their lengths. The addition of constraints, such as flanges at the end of the bend, greatly increases the bending rigidity. The longitudinal stress factors at the middle surface are considered to be the most important for calculating stresses in piping systems. These are some of the conclusions as contained in the paper Properties of Thin-Walled Curved Tubes of Short-Bend Radius, by T. E. Pardue and Irwin Vigness, both of the mechanics division, Naval Research Laboratory.

Flexibility factors and stress-intensification factors were measured for a group of thin-walled tube bends having a ratio of pipe radius to bend radius of $\frac{1}{3}$. A theoretical analysis, which eliminates some of the simplifying assumptions of previous theoretical analyses, is included for comparison with experimental data. Reasonably good agreement between theory and experiment was found for U bends and 90 deg bends with straight sections of piping attached to the end of the bend.

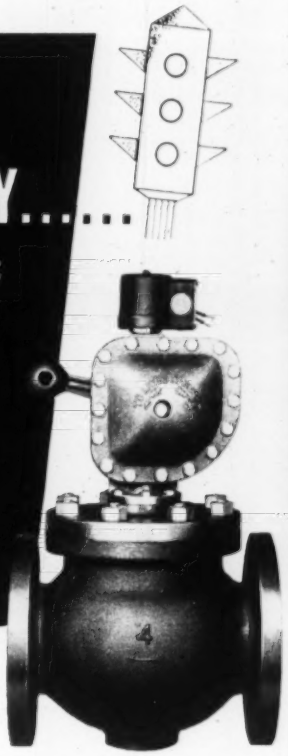
Identified as No. 50-S-21, the paper was presented at the recent spring meeting of the American Society of Mechanical Engineers, 29 W. 39th St., New York 18.

ASCO SOLENOID VALVES

HERE'S THE

# SAFETY.....

AUTOMATIC SHUT-OFF VALVE FOR THAT GAS BURNER!



It's "Factory Mutual Approved," meaning that it has passed very rigid tests as to tight seating and reliability of operation!

This ASCO Safety Shut-off Valve is designed to protect personnel and apparatus heated by gas for it provides a sure automatic cut-off of the flow of gas to the burner should something go wrong necessitating instant shut-down. On failure of energizing current it closes instantly and remains closed until the current is restored *and* it is opened manually. The safety function is automatic; restoration to service is manual!

If you are operating or designing gas burners or gas-fired equipment, you will be interested in the full details of ASCO "Factory Mutual Approved" Safety Shut-off Solenoid Valves. Write us. If you are interested in other automatic flow control of gas or liquids, we have many other types of solenoid valves.

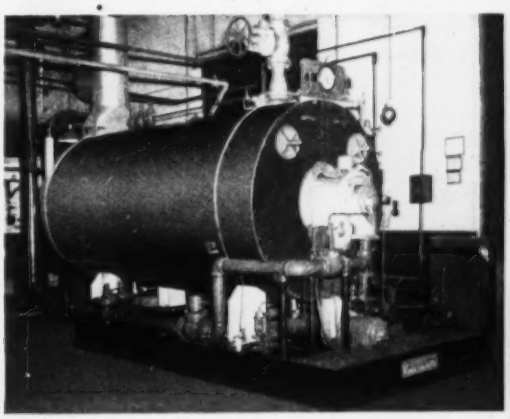
ASCO Solenoid Valves

When in need of Automatic Transfer Switches, Remote Control Switches, Contactors, Relays, and Specialized Electromagnetic Controls, come to us.

**Automatic Switch Co.**

389 LAKESIDE AVENUE · ORANGE, NEW JERSEY

"Powermaster gives us FUEL SAVINGS beyond expectations!"



writes *E. Milota*, general manager of *Buckeye Garment Rental Company, Cleveland, Ohio*, about new 200 HP unit installed in their industrial laundry. "Its automatic operation assures ample steam regardless of load variation!"

Steam users throughout the world report their operating costs are reduced as much as 40% through Powermaster installations. High and low pressure units from 15 to 500 HP—for light oil, heavy oil, gas or combination gas-oil firing—give you advantages like these:

- Low fuel consumption through high efficiency
- Low-cost installation due to packaged design
- Reduced man-hours through automatic operation
- A.S.M.E. construction—Underwriters' approval
- Widespread service by factory-trained men

***Free catalog mailed promptly — use coupon below***

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**STEAM GENERATORS**

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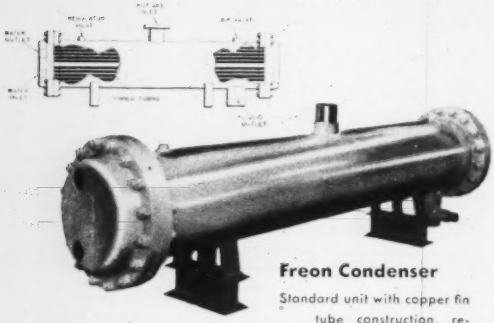
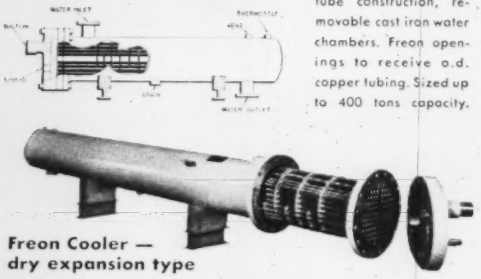
**...refrigeration components you can rely on**



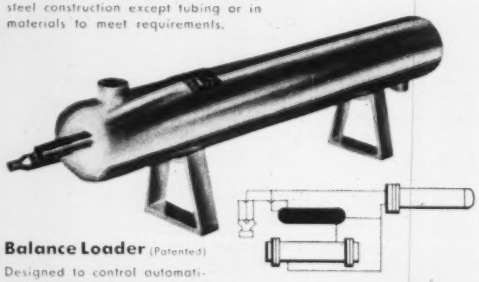
**Freon Condenser**

Standard unit with copper fin tube construction, removable cast iron water chambers. Freon openings to receive o.d. copper tubing. Sized up to 400 tons capacity.



**Freon Cooler — dry expansion type**

Billet type carbon steel freon chamber with adapters for o.d. copper tubing; removable tube bundle; U-shaped copper tubing; carbon steel construction except tubing or in materials to meet requirements.



**Balance Loader** (Patented)

Designed to control automatically refrigeration capacity in accordance with load demands.

**Here you have three very useful auxiliary units for that refrigeration system you are laying out or installing. Our engineers will be glad to recommend proper types and sizes for your requirements.**

Literature on all Patterson Equipment available.

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# RECENT TRADE LITERATURE

*For your convenience in obtaining copies of these bulletins, see coupon on page 187. If you write direct to the manufacturer, describe carefully what literature you want, as the number given first in each item is for use only when sending requests to Heating, Piping & Air Conditioning.*

**HPAC 101—ADHESIVE CEMENT**—Benjamin Foster Co., 4635-37 W. Girard Ave., Philadelphia 31, has issued a number of data sheets on its adhesive cement. Type 81-63 brushing adhesive is for use with low density insulation and type 81-66 trowelling adhesive is for use with high density insulation. These two products are for use in adhering insulation to sheet metal ducts. Insulation sealer 30-53 has been prepared for sealing seams in thermal insulation, especially cellular glass. It is recommended particularly for insulation which must be removed periodically. Liquid rubber cement 81-65 is said to be a fast setting cement for quick adhesion of thermal insulation, tapes, cloth lagging, or metal foils.

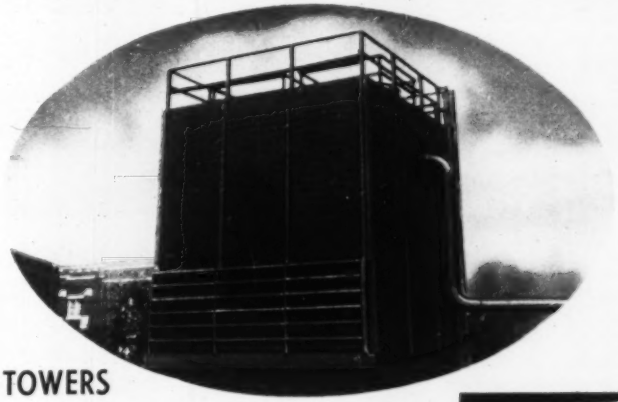
**HPAC 102—AIR CONDITIONING CONTROL SYSTEM**—A new folder issued by Foxboro Co., Foxboro, Mass., describes and illustrates the company's instruments which are used to monitor the operation of the entire air conditioning system in the new 26 story home office building of the John Hancock Mutual Life Insurance Co. Instruments on the central panelboard show a complete picture of temperature and humidity at key points throughout the building.

**HPAC 103—AIR CONTROL VALVE**—Bulletin AU-250 of Bellows Co., Akron, Ohio, covers the "Electroaire" valve, which is a packaged air control unit consisting of a four-way directional slide valve, solenoid controls, and piston speed regulators.

**HPAC 104—AIR ELIMINATOR**—The No. 12 high pressure air eliminator of Gorton Heating Corp., Cranford, N. J., is designed for quick and automatic venting of dryers, steam coils, steam mains, unit heaters, processing equipment, etc. at steam pressures up to 150 psi. It is described and illustrated in Bulletin 119.

**HPAC 105—AIR FILTER**—The latest addition to the line of "Staynew" dry panel filters is the model WKE-8. The filter is 24 in. × 24 in. × 8 in. deep and the air filter material most generally used is "Feltex" paper, either 6 or 10 ply, though other media are available for special conditions. Detailed information is given in an 8 page bulletin issued by Dollinger Corp., 11 Centre Park, Rochester 3, N. Y.

**HPAC 106—AIR GRILLE SELECTOR**—Barber-Colman Co., Rockford, Ill., has prepared a slide rule type instrument for rapid sizing of its ventilating and air conditioning grilles. Grille size is based on noise level, air volume, flow, and ceiling height. A table of maximum allowable noise levels for different installations is printed on the face of the rule. According to the company, the range of variables is great enough for the selection of a grille for any common application.



Left: United one cell induced draft tower, series M16, in ice plant refrigeration service.

## UNITED COOLING TOWERS

*for Air Conditioning and Refrigeration*

Complete line "package" type spray towers at low standardized prices.
Individually designed and constructed mechanical draft equipment in any required capacity.

*Write for Bulletin No. 50 showing typical United installations in power, oil, gas and refrigeration service.*

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PORTER BLDG. KANSAS CITY 2, MISSOURI
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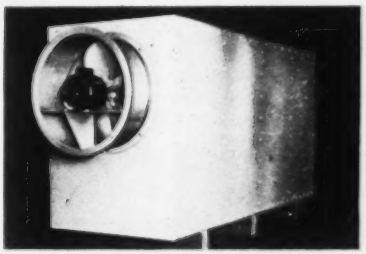
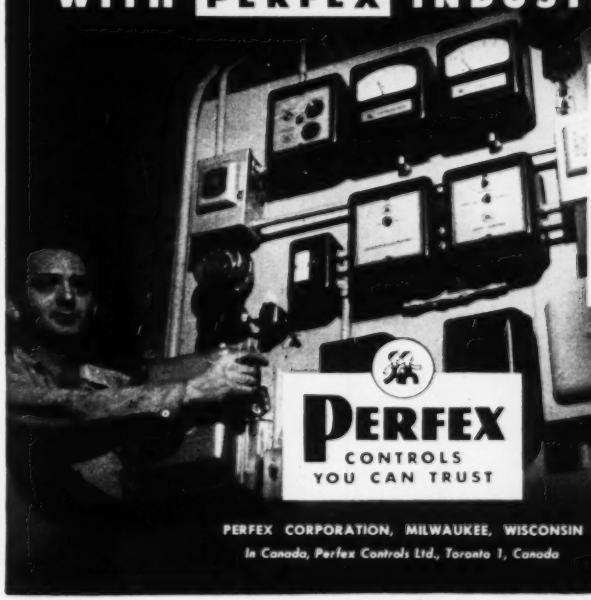


United LoTemp series, forced draft "packaged" unit. 5—7.5—10—15—20 ton capacities.

## OVER $1000 FUEL SAVINGS PER YEAR WITH PERFEX INDUSTRIAL CONTROLS




**"It's true!** Now, with efficient and dependable boiler equipment we are no longer troubled with excessive smoke. Fuel savings *alone* have paid for our PERFEX Controls and Instruments in less than one year... And that does not include the extra savings on maintenance. Best of all, we'll be saving money for years to come...thanks to PERFEX Controls."

I. B. Fort, Chief Engineer, Friendship Laundry Service, Chicago, Illinois.

**CONSERVE FUEL • INCREASE EFFICIENCY**
**SAVE TIME! • SAVE MONEY!**

WITHOUT OBLIGATION CLIP AND MAIL TODAY!
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Send me more information on Perfex equipment for my boiler room.

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*In Canada, Perfex Controls Ltd., Toronto 1, Canada*

**NEW...**

**DUAL SWITCH THERMOSTAT**

***MODEL NWDH for Controlling Air Conditioning Systems!***

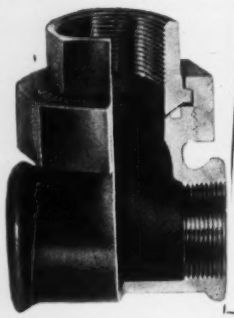
The Type NWDH dual switch thermostat with remote bulb for duct mounting is being used in applications in which it is desired to handle two electrical circuits from a single thermal assembly. Typical installations include the control of two compressors, one for normal operation and one for peak loads; or a fan and a compressor.

Standard switches are rated at 15 amps 125/250 V. AC. Switches rated at ¾ hp 125 V. AC, 1½ hp 250 V. AC are also available.

**UNITED ELECTRIC CONTROLS COMPANY**
87 School Street
Watertown, Mass.

Whatever your control problem may be, United Electric Controls Co. is prepared to assist you. Send full details and drawings. Write for bulletin giving complete details on the control mentioned above.

STANDARD & SPECIAL THERMOSTATS & PRESSURE SWITCHES



**IMPORTANT SAVINGS ON PIPING MAINTENANCE WITH JEFFERSON SPECIALITY UNIONS**

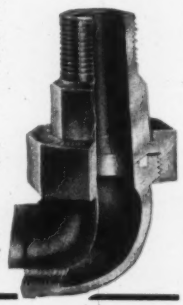
*AND HERE ARE JUST A FEW OF THE REASONS WHY!*

★ You'll do better with Jefferson Unions because they are made of a very fine malleable iron having a tensile strength of 55,000 lbs. per sq. in. . . . because all brass rings are

★ cut from special tubing instead of cast . . . . because all channels for seating rings are machined rather than cast, preventing rocking of the seat . . . . because all Jeffer-

★ son Unions are air tested for leakage before shipment.

*A trial order will convince you and we'll be glad to service you in a hurry. Just write today to the address below.*



**JEFFERSON UNION CO.**
607 West 26th Street, New York 1, N. Y.
35 Fletcher Avenue, Lexington 73, Mass.
65 Gooding Street, Lockport, N. Y.


**HPAC 107—APARTMENT HEATING AND CONTROL SYSTEMS**—A new manual describing modern methods of apartment heating and heating control has been published by Minneapolis-Honeywell Regulator Co., 2604 Fourth Ave., S., Minneapolis 8. The booklet discusses heating design and layout for all types of apartment buildings and all types of heating. It covers the various control systems recommended and includes detailed drawings and explanations of a system which permits individual tenant control.

**HPAC 108—BOILER RETURN SYSTEMS**—A new 16 page catalog has been released by Fred H. Schaub Engineering Co., 2116 S. Marshall Blvd., Chicago 23, illustrating and describing its standard and special type boiler return systems. In addition to covering applications and including complete descriptive data and specifications, the booklet features illustrations of "Master-Bilt" boiler feed pumps with "Fleximatic" mechanical seals and permanently lubricated ball bearings, "Chromasoid" lined condensation receivers, and "Magnetrol" boiler water level controls. Also featured is a discussion of what to look for when buying a return system.

**HPAC 109—CAST IRON AND MALLEABLE PIPE FITTINGS**—Catalog 50F of Stockham Valves and Fittings, Inc., Box 2592, Birmingham 2, Ala., covers the company's line of cast iron and malleable pipe fittings. In addition to a photograph of each fitting, there is a dimension drawing and the price, weight and dimensions are given for each listed size.

**HPAC 110—CELLULAR RUBBER**—"Spongex" is chemically blown cellular rubber which is flexible, elastic, compressible, light, and has low thermal conductivity. It is described and illustrated in a new 12 page catalog issued by Sponge Rubber Products Co., Shelton, Conn. As described in the catalog, it is available in a variety of forms and is recommended for gasketing, sealing, insulating, cushioning, dustproofing, shock absorption, and sound and vibration damping.

**HPAC 111—COMPRESSORS, CONDENSING UNITS**—A revised eight page capacity chart, (204-5) illustrating and describing its complete line of refrigeration compressors and condensing units has been released by Mills Industries, Inc., 4100 Fullerton Ave., Chicago 39. Specifications, capacities, and essential data are included on air cooled units, ¼ to 3 hp; water cooled units, ⅓ to 10 hp; combination air-water cooled units, ½ to 3 hp.

**HPAC 112—CORROSION CONTROL**—Calgon, Inc., Subsidiary of Hagan Corp., Hagan Bldg., Pittsburgh 30, is offering a new folder which describes and illustrates its "threshold treatment" whereby minute quantities of "Calgon" are used to protect industrial, commercial and municipal water systems against general corrosive attack, eliminate "red water," and control corrosion of hot water systems and industrial cooling systems where water temperatures accelerate attack.

**HPAC 113—$CO_2$ FIRE EXTINGUISHING SYSTEM**—A new $CO_2$ fire extinguishing system of American-LaFrance-Foamite Corp., Elmira, N. Y., is designed to

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## 22 BRANCH OFFICES

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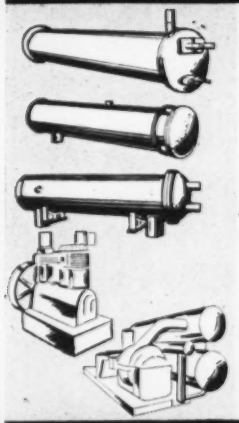
Whatever the problem... if it's concerned with CONTROLS... in heating, refrigeration, aircraft or industrial processing . . . there's a better solution at General Controls. For General Controls actually do more and cost less. So if you have a product or process where control is vital... check with any of the 22 conveniently located General Controls Branch Offices for better results... faster!

**GENERAL CONTROLS**
801 Allen Avenue, Glendale 1, California
*Manufacturers of Automatic Pressure, Temperature, Level and Flow Controls*

# QUICK - PROMPT RETUBING SERVICE



on
FREON - AMMONIA - $CO_2$
CONDENSERS AND COOLERS
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STEAM CONDENSERS

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ANYTHING WITH TUBES

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Refrigerating Compressors
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on Hand

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100 River Street Hoboken, N. J.
For New Equipment - Write our general office
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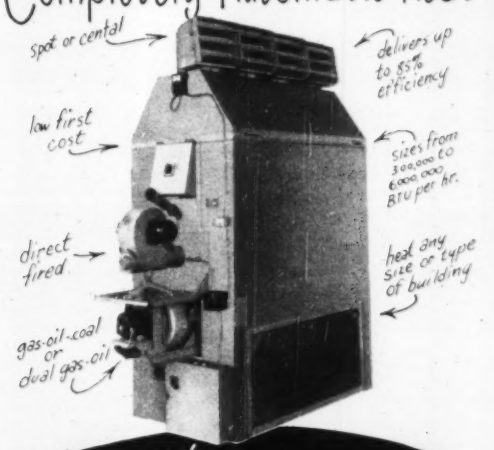
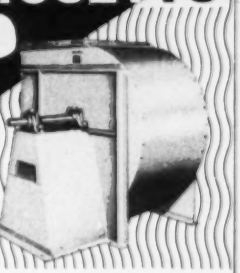
# Completely Automatic Heat


spot or central
low first cost
direct fired
gas-oil-coal or dual gas-oil
delivers up to 85% efficiency
sizes from 300,000 to 6,000,000 BTU per hr.
heat any size or type of building

**Olson**
Get full information—write for catalog
ARTHUR A. OLSON CO. CANFIELD, OHIO

# MASSACHUSETTS
## Squirrel Cage and Power Fixed FANS



### SQUIRREL CAGE FANS

Fan wheels have low speed characteristics. The low air velocities permitted are conducive to efficient operation. Housings are rugged and compact. Wheel sizes Single Width 13½" to 86½" dia. Double width 18" to 86½" dia.

### POWER FIXED FANS

Backward curve blade type with non-overloading characteristics. Housings are constructed of steel plate and reinforced with heavy bracing angles. Wheel sizes Single Width 13½" to 86½" dia. Double Width 18" to 86½" dia. Class I or Class II construction for better fan selection.

*Write for catalogs.*

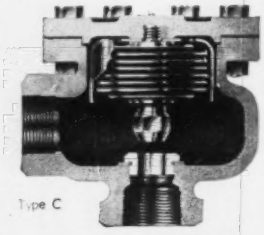
MASSACHUSETTS BLOWER DIVISION
**The BISHOP & BABCOCK Mfg. Co.**
4901 HAMILTON AVENUE CLEVELAND 14, OHIO

Nicholson Steam Traps Feature

**MAXIMUM AIR VENTING**

for Faster Steam Transfer

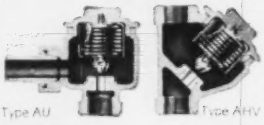
Substantial evidence of the venting effectiveness of Nicholson steam traps is their wide recommendation for eliminating non-condensible gases, as well as condensate, in such equipment as jacketed kettles. Other Nicholson features: operate on lowest temperature differential; 2 to 6 times average drainage capacity.



Type C

*5 Types for Every Plant Application*

Process, heat, power. Size ¼" to 2"; pressures to 225 lbs.



Type AU Type AHV

*BULLETIN 450 or see Sweet's*

**W. H. NICHOLSON & CO.** 198 Oregon St. Wilkes-Barre, Pa.

Sales and Engineering Offices in All Principal Cities

QUALITY always wins!

**MARTOCELLO Products are fully DEPENDABLE**

ATOMIZING SPRAY NOZZLES, SPRAY POND NOZZLES, AND CONDENSER WATER DISTRIBUTORS

For Vertical Shell and Tube Ammonia Condensers

ALL MARTOCELLO SPRAY NOZZLES are manufactured with precision and of a design which has been thoroughly tested for maximum results and durability. They are guaranteed to give satisfaction. Successful, efficient results depend largely upon selecting the proper number, type and size of Nozzles suitable for your installation.

THE MARTOCELLO CONDENSER WATER DISTRIBUTORS are now used as standard equipment by Progressive Refrigerating Engineers in solving their manpower problem, because they require no attention and assure users of the lowest Condenser Operating Pressures and Minimum Power Cost. It will pay you to consult us. WRITE or WIRE for further information.

*Prompt Shipment From Stock*

**Jos. A. Martocello & Co.** 229-231 NORTH 13th STREET PHILADELPHIA 7, PA.

Serving the Ice Industry Since 1918 — There is no Substitute for MARTOCELLO QUALITY

automatically sound a warning when fire occurs, stop motors, close windows, shut off fans, close doors, and put out the fire. A number of leaflets, recently issued, illustrate and describe various industrial and commercial applications.

**HPAC 114—FASTENERS**—Forty-nine stock sizes of the "Speed Grip" nut retainer have been established by Tinnerman Products, Inc., 2036 Fulton Rd., Cleveland, and are described in a booklet recently issued. The retainers are used for fastening square nuts to sheet metal parts. Included in the booklet is a description of the fastening principle and specifications of each stock size.

**HPAC 115—FLEXIBLE METAL HOSE**—A four page bulletin, released by the Eclipse-Pioneer Div. of Bendix Aviation Corp., Teterboro, N. J., covers a new series of mechanical type renewable flexible fittings. Specifications are tabulated and installation procedures are illustrated. Sizes range from $^1/_4$ to 2 in.

**HPAC 116—GLASS PIPE AND FITTINGS**—Glass pipe and fittings in $^1/_4$ in. through $^3/_4$ in. sizes are illustrated and described in a new catalog (No. 94) released by Fischer & Porter Co., Hatboro, Pa. Also included is information on a recently introduced metal-to-glass and glass-to-glass pipe coupling available in $^1/_4$ in. through 1 in. sizes.

**HPAC 117—HEATING, VENTILATING, AIR CONDITIONING EQUIPMENT**—The Vol. 14, No. 1 issue of the house organ published by The Trane Co., La Crosse, Wis., features case histories which illustrate the use of the company's unit ventilators in schools and the use of air conditioning equipment for a combination of a unit and a central conditioning arrangement in an office building. Also included is a discussion of summer ventilation for industrial buildings by A. H. Kaulfuss.

**HPAC 118—INSULATION FASTENERS**—"Stic-Klips" are used for applying insulations on regular and irregular surfaces of heating, ventilating, air conditioning, and industrial processing equipment operating at temperatures from sub-zero to 300 F. Application Bulletin No. 2 of Stic-Klip Mfg. Co., 50 Regent St., Cambridge 40, Mass., covers preliminary design considerations, insulation clearance, clip selection and spacing, and various insulation applications.

**HPAC 119—METAL RACKS**—Catalog No. 600 of Unistrut Products Co., 1013 W. Washington Blvd., Chicago 7, includes a compact presentation of the company's line of "Unistrut" metal racks and includes 46 different photographs of typical rack applications. Complete drawings of the various sizes of metal channels and basic fittings recommended in the building of most racks are also included. They are said to be completely adjustable to meet changing requirements and feature bolted frame construction.

**HPAC 120—NONRETURN VALVES**—"Cushioned triple acting" nonreturn valves for steam control in case of damaged boilers or headers are described in a new eight page bulletin released by Golden-Anderson Valve Specialty Co., Keenan Bldg., Pittsburgh 22. Available in

# MORE...

*for the Master Plumber from HAJOCA in 1950*

Yes, Hajoca is planning a big campaign of cooperation with master plumbing and heating contractors. Newspaper ads, direct mail, help with time payments . . . all designed to build better business and increase profits will be ready soon.

New ideas and equipment for the home will feature famous names in kitchen equipment, water and heating systems and bathrooms.

Be sure to keep in touch with your local Hajoca Branch and be ready to cash in on these great business builders.

**HAJOCA CORPORATION**

*General Offices:* **31st and Walnut Street Bridge**
**Philadelphia 4, Pennsylvania**

**32 BRANCHES SERVING THE ATLANTIC SEABOARD**

*See Your Classified Telephone Directory for Local Branch Address*

# Water Shortage?

*HERE'S THE ANSWER—*

**B.A.C.** **Evaporative Condensers**

*in Sizes 10 T.R. to 210 T.R.*

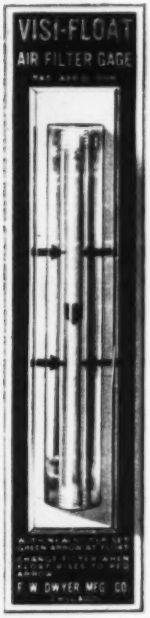
. . . and COOLING TOWERS

*in Sizes 7½ T.R. to 100 T.R.*

**They Use 95% Less Water!**

**Baltimore Aircoil Co., Inc.**

711 W. PRATT ST. • BALTIMORE 1, MD.




*New* FILTER GAGE!

DWYER

# VISI-FLOAT

**ONLY $3.25**

First gage of its type for **permanent** mounting on forced air units. Low-cost . . . foolproof . . . self-operating. Tells at a glance from face of heater, air-conditioner, or ventilator when filters are clogged and need replacement. No liquids, no mechanical parts to break down. VISI-FLOAT comes ready to use. A clear, lifetime, lucite body with a floating indicator. Connected across filter, and reacts constantly to varying pressure drop due to dirt accumulation. Lasts the life of the unit. Just drill two holes and mount. Let VISI-FLOAT cut fuel bills, allow more and cleaner air flow, reduce blower failure and repairs.

*Send for descriptive folder.*

**F. W. Dwyer Mfg. Co.**

323 South Western Avenue
Chicago 12, Illinois

*Slimmer . . . Trimmer*

**BROWN BAYCE-HEET**

*Protrudes only 1⅛" from Wall*

- Smart looking, protrudes only 1⅛".
- 645 B.T.U. per lineal foot with 180° water temperature.
- Fins have amazing heat area due to exclusive beading process which provides greater radiation surface and durability.
- 5 ft. standard unit weighs only 12 lbs. . . . requires only 3 simple wall brackets to install. Easily cut to any desired length.
- Closed top and open front prevent streaking wall.
- Removable front for easy cleaning.

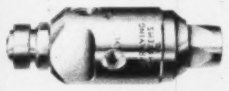
*Illustrated Brochure 4P on Request*

**BROWN PRODUCTS COMPANY FOREST HILLS, NEW YORK**

**are you "up-to-date" on SPRAY NOZZLE developments . . . *for example***

✓ Spraying Systems Pneumatic Atomizing Nozzle with Cleanout Needle . . . spring loaded cleanout needle is open in normal position. When pushed into orifice, cleans out entire orifice passage. Write for Data Sheet 4198.

✓ Spraying Systems Pneumatic Atomizing Nozzle for Automatic Operation . . . provides intermittent operation. Typical use is automatic lubrication of molds . . . with lubricating operation indexed to press cycle. Write for Data Sheet 4547.

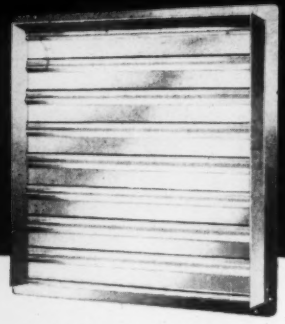


✓ Spraying Systems Pneumatic Atomizing Nozzle with Steam Jacket . . . for spraying liquids requiring above-room temperature. The nozzle is easily removed from the jacket. Write for Data Sheet 4610.

WRITE and tell us the details of what you want to accomplish in spraying . . . our engineering facilities are at your service. Also . . . do you have General Catalog No. 22?

**SPRAYING SYSTEMS CO.** 3219 RANDOLPH STREET BELLWOOD, ILLINOIS
*(Suburb of Chicago)*

*they all want* **AIR-FLO**



MODEL A-555

THE AUTOMATIC SHUTTER WITH ALL THE FEATURES

FRONT VIEW—CLOSED

**IT TAKES THE LOAD OFF THE FAN!**

Aluminum louvers open fully, permitting capacity fan operation. New heavy reinforcement strip adds strength and long life to the louvers, assures quiet operation and perfect counterbalance, prevents rattling. Deep shroud protects shutter from high winds. Tie-rod, brackets and bearings inside frame, not exposed to weather. Special finish resists corrosion. Many other features.

WRITE FOR NEW AIR-FLO CATALOG 43-D

*Illustrations and details of the complete Air-Flo line.*

**AIR CONDITIONING PRODUCTS CO.**
**2340 W. LAFAYETTE BLVD. • DETROIT 16, MICH.**


sizes from 2 to 30 in. and for pressures from 125 to 1500 psi, these valves are designed to automatically isolate a damaged boiler against reverse steam flow as well as close down steaming boilers due to a ruptured steam line or header beyond the valve.

**HPAC 121—OCCUPATIONAL GUIDANCE**—The No. 1 issue in a series of booklets entitled Opportunities Today in the World of Tomorrow is available from the Milwaukee School of Engineering, Milwaukee 1, Wis. Devoted to refrigeration, heating, and air conditioning, this issue discusses production and sales problems in the field. Also covered are the jobs in industry that students can enter at various stages of their education. Copies of the booklet may be obtained from the school for 10c.

**HPAC 122—PIPELINE STRAINERS**—Bulletin S-203 of Yarnall-Waring Co., Mermaid Lane, Philadelphia 18, provides up-to-date data on "Yarway" screwed strainers, $\frac{1}{4}$ to 3 in., and expanded details on flanged strainers, $\frac{1}{2}$ to 5 in.

**HPAC 123—PIPING HOOK-UPS FOR STEAM SPECIALTIES**—Sarco Co., Inc., Empire State Bldg., New York City, has published the sixth enlarged edition of its booklet on steam hook-ups for steam traps, air vents, and industrial temperature controls. Correct steam trap selection and calculations for steam trap sizes are discussed, and tabulated data include properties of saturated steam, capacities of standard steel pipes, flange standards, standard pipe and pipe threads, average hot water requirements for various types of buildings, etc. Free copies of this 63 page manual are offered to maintenance engineers who write on their firm's letterhead.

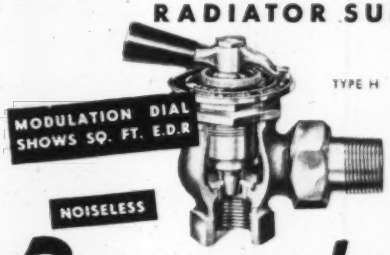
**HPAC 124—POLYPHASE ELECTRIC MOTORS**—Bulletin EM4-812 of A. O. Smith Corp., Motor Div., Los Angeles 22, covers polyphase electric motors in sizes from 1 to 75 hp. Design and construction features are described and are illustrated in cross section and cutaway views.

**HPAC 125—PRESSURE REDUCING, RELIEF VALVES**—Bulletin 283 of A. W. Cash Valve Mfg. Corp., Decatur 60, Ill., describes changes, additions, and improvements in a line of pressure reducing and regulating valves. Also described is a new, automatic reseating relief valve.

**HPAC 126—PRICE SCHEDULE FOR TUBE BENDING**—In connection with its recently announced special department for fabrication related to the production of seamless and welded tubing, Babcock & Wilcox Tube Co., Beaver Falls, Pa., has issued a complete price schedule for the cold bending of all classes of tubing. The schedule covers prices for bending seamless and welded carbon, alloy and stainless steel tubing and reflects such factors as number of bends per tube, the number of tubes on a job, outside diameters, short straight sections, number of planes, and the lengths of tubing.

**HPAC 127—PROTECTIVE COATING**—Insul-Mastic Corp. of America, Oliver Bldg., Pittsburgh 22, has prepared a four page folder on its plastic protective coating

RADIATOR SUPPLY VALVES




# Barnes & Jones

Adjust while operating

The Type H Orifice Valve is instantly adjustable and shows the EDR setting at a glance. No dis-assembly necessary. Steam or Hot Water service.

Your B&J Specialist can recommend the correct type of radiator supply valve for economical efficient service.

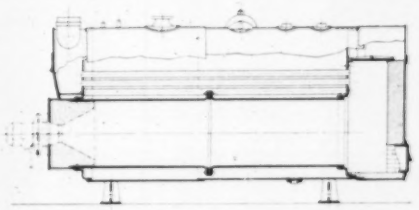
TYPE F Quick Opening

TYPE K Modulating

Other B & J specialties include: Thermostatic Traps, F & T Traps, Boiler Return Traps. All pressure ratings. Send for Catalog 76.

Barnes & Jones 128 BROOKSIDE AVE. BOSTON 30, MASS.





## Boilers Built for Gas or Oil by Brownell

The drawing indicates how a Brownell Scotch Boiler can be arranged to accommodate any of a wide range of gas or oil burners.

Due to the large area of heating surface in this type of boiler, gas or oil firing is unusually efficient and economical. Furthermore, the low construction is a distinct advantage where head room is limited. These boilers are also widely used for coal hand firing.

Brownell Scotch Boilers are built in 12 sizes ranging from 10 to 180 h.p. for pressures of 15 to 150 lbs.

The subject is fully covered in Bulletin No. 8-B. *Ask for a copy.*

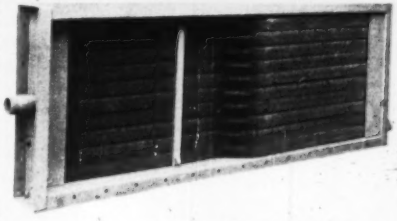
**The Brownell Company**

408 North Findlay Street Dayton 1, Ohio



# G&O COILS

*for* HEATING *and* COOLING



A full line of sizes now available to meet all industrial requirements.

Send for catalog.

**THE G&O MANUFACTURING COMPANY**

New Haven 8, Connecticut

*Pioneer Manufacturers of Square Finned Tubing in the United States*



## New "Freight Elevator" Loads Trucks—Cuts Costs

## ANTHONY "LIFT-GATE"

**Now for 1/2 & 3/4 Ton Pick-up Trucks**

- ONE MAN OPERATION
- LIFTS OR LOWERS UP TO 800 LBS.
- SPEEDS DELIVERIES & PICK-UPS
- PREVENTS DAMAGE TO VALUABLE CARGO
- DRAMATIZES DELIVERIES — BUILDS BUSINESS
- SIMPLE—FAST—EFFICIENT

Twin hydraulic cylinders attach directly to gate—no cables, chains or cranks. Operated by hydraulic pump driven by fan belt. Equipped with throwout clutch, pump runs only when needed. By-pass valve prevents "overloading." Single lever control raises, lowers, or holds gate at any elevation. Gate stops automatically at ground and floor levels. Self contained lift mechanism does not interfere with canopy top, sign panels, spare tire or bumper.

*Amazing Low Price. Write for Complete Information*

ANTHONY Pick-up LIFT GATE HYDRAULIC

ANTHONY CO.

DEPT. 308 STREATOR, ILL.

**KEY-TITE** Water, gas, low-pressure steam and compressed air lines are completely sealed when you use KEY-TITE. This lead-free compound does not affect taste or odor of potable liquids.

**KEY GRAPHITE PASTE**

Oil, gasoline, kerosene and high-pressure steam lines require the perfect seal provided by KEY GRAPHITE PASTE. With KEY, pipe joints are sealed and lubricated at the same time.

Pipe joints and fittings sealed with Key Pipe Joint sealing compounds do not leak. Connections will not freeze and re-opening is easy.

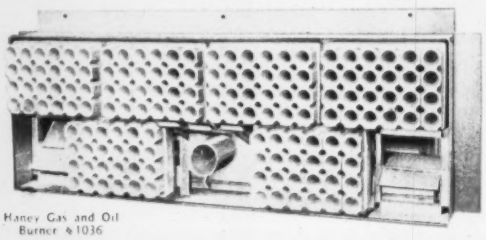
There is a Key compound to fit your pipe joint sealing requirements. Send for free sample.

KEY Company

**KEY COMPANY**
2617 McCasland Ave.
East St. Louis, Ill.

*The Haney . . .*

**1000 SERIES HORIZONTAL BURNERS**



Haney Gas and Oil Burner #1036

The HANEY 1000 SERIES BURNERS arranged in many shapes and sizes are complete with windbox, full size gas manifold, automatic vane type air louvre and linkage, tailor-made for your installation giving long life, free from trouble.

Full modulation and operation at pounds or inches of pressure make them suitable for all types of horizontal firing.

*We'll be glad to send more information on request . . . please write!*

**HANEY** GAS BURNER AND ENGINEERS

909 South Myrtle Street, Monrovia, California


system. Among various applications, the "Insul-Mastic Vinyl" system is recommended for providing a jacket for thermal insulation, especially where tanks, ducts, and other vessels must stand outdoors. Where the insulation to be protected is soft and pliable, the vinyl coating is first applied and forms a base for a "Gilsonite" protective coating.

**HPAC 128—REFRIGERATION COMPRESSORS**—A new edition of 60 page Catalog 204-1 has been prepared by Mills Industries, Inc., 4100 Fullerton Ave., Chicago 39. Information is given on compressors and condensing units (air cooled, $\frac{1}{4}$ to 3 hp; water cooled, $\frac{1}{3}$ to 10 hp; and combination air and water cooled, $\frac{1}{2}$ to 3 hp). The catalog contains specifications, dimensions, and revised data for selecting units for cooling, refrigeration, and air conditioning.

**HPAC 129—REFRIGERATION DRYER**—Constant moisture pickup under refrigerating conditions with processed granular "DuCal" at all liquid line temperatures is said to make possible the accurate rating of "DFN" refrigeration dryers. McIntire Connector Co., Newark 5, N. J. has released Bulletin DG-1 which features a number of selection charts for sizing its dryers in accordance with the evaporator temperature and horsepower rating. Separate charts are used for air and water cooled units.

**HPAC 130—REMOTE CONTROL**—Hydraulic remote controls for industrial use are described in Bulletin 20-105, a new publication of Sperry Products, Inc., Danbury, Conn. Two series of controls and available accessories, including an intermediate transmitter for use at secondary control stations, are described.

**HPAC 131—ROOM AIR CONDITIONERS**—Quiet-Heet Mfg. Corp., 135 N. J. Railroad Ave., Newark 5, N. J., has released two data sheets on its model G-5, $\frac{1}{2}$ hp. room air conditioner, and on the G-7, $\frac{3}{4}$ hp. unit. In addition to covering design and construction features, data are given on capacities, dimensions, etc.

**HPAC 132—RUST PREVENTING, METAL TREATING OIL**—"Peroline" is an oil-like chemical for producing an oiled phosphate coating on iron and steel products that are later to be painted, to prevent rusting in storage or transit. A new data sheet of American Chemical Paint Co., Ambler, Pa., tells what it is, what it does, conditions under which it is used, how it is used, etc.

**HPAC 133—SCHOOLROOM VENTILATION**—A new booklet on the company's system of classroom ventilation has been prepared by Herman Nelson Div., American Air Filter Co., Inc., Moline, Ill. The booklet graphically portrays mechanical features and advantages of this system in heating and ventilating school classrooms.

**HPAC 134—SOLENOID VALVES**—Automatic Switch Co., 391 Lakeside Ave., Orange, N. J. A new four page folder briefly describes and illustrates various types and applications of "Asco" solenoid valves. Also outlined are electromagnetic controls, including transfer switches, remote control switches, relays, contactors, etc. The company's 72 page valve catalog (No. 23) has recently been released.

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Underground Steam Conduit System

## Brownsville Houses

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Beginning with the Jan., 1949 issue of Heating Piping & Air Conditioning we have talked about nothing but Therm-O-Tile jobs in New York City alone—in the huge housing projects in that city. Above we show the Brownsville Houses, one of the many jobs in which Therm-O-Tile Underground Steam Conduit was specified.

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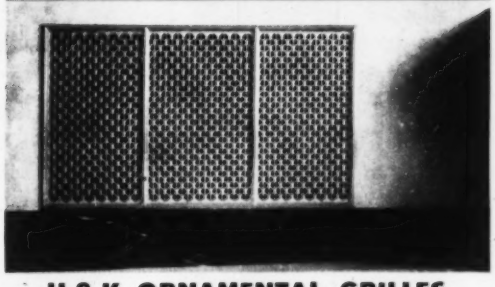
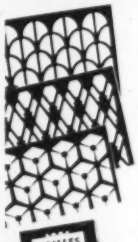


## H & K ORNAMENTAL GRILLES



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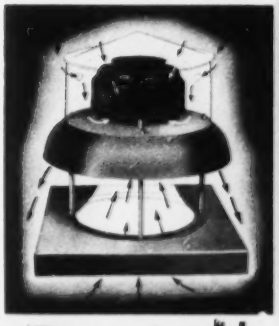

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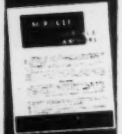

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**HPAC 135—STEEL PIPE PRICE DATA**—A new data card designed to help individuals involved in purchasing carbon steel pipe or estimating the cost of apparatus using this material has been issued by Babcock & Wilcox Tube Co., Beaver Falls, Pa. Identified as TDC 135, the card tabulates prices per hundred feet of seamless carbon steel pipe, $1\frac{1}{2}$ in. in nominal diameter and smaller and in all quantity brackets.

**HPAC 136—V BELTS**—Two new booklets recently issued by Maurey Mfg. Corp., 2915 S. Wabash Ave., Chicago 16, give detailed information on the company's line of "Mor-Grip" fractional horsepower and multiple v belts. Bulletin FHP-101 describes the line of v belts for fractional horsepower applications, and Bulletin MV-201 covers multiple v belts.

**HPAC 137—WATER CONDITIONER**—A new bulletin (4801) covering the new water conditioner of Cochrane Corp., 3131 N. 17th St., Philadelphia 32, describes the company's hot process zeolite water conditioner, a two-stage softener in which the first stage is the hot process, using lime or dolomitic lime, followed by the zeolite softener, said to reduce the residual hardness to zero.

**HPAC 138—WELDING CAST IRON**—A study of cast iron welding failures and methods of overcoming these faults has been published by Eutectic Welding Alloys Corp., 40 Worth St., New York 13. The basis for most of the savings shown in the study is the use of the company's "EutecTrode" 24. A number of case histories are included, as well as data on welding cast iron.

---

### Explains Selling and Distribution of Machinery, Equipment, Technical Products

The second edition of Sales Engineering, by Bernard Lester, of Lester, Hankins & Silver, management engineers, has been prepared to inform the younger technically trained or engineering graduate of the character of work done by the sales engineer and the opportunities that exist for his services. It should also be of help to the large army of technical men engaged in either selling or supervising distribution and sales. Besides these two groups, there are many executives or engineers engaged in design, production, or counselling, who will benefit by obtaining a clearer picture of distribution and selling.

Mr. Lester has been with Westinghouse Electric Corp. for many years. He has been successively manager of the small motor division, manager of the resale department (selling component parts to industrial manufacturers), and assistant industrial sales manager. In the second edition, he has rearranged the text and expanded many sections. Several practical examples dealing with improved techniques have been added. All in all, this new edition has been enlarged by about 10 percent to cover the subject more completely and to include suggestions made by users of the book. The text is divided into five parts dealing with sales engineering, buying and selling, the sales engineer in action, selling to those who buy for resale, and the training and development of the sales engineer.

Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, and priced at $3.00, the clothbound book contains 226 + ix ($5\frac{1}{2} \times 8\frac{1}{2}$ in.) pages.

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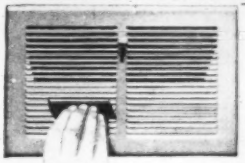

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CONSULTING ENGINEER wants air conditioning junior engineer; prefer mechanical engineering graduate who is also graduate of Carrier or York factory application training schools with two or more years field experience. opportunity for worker and learner with future dependent upon results produced; single-man preferred; complete details, photo, availability, salary record and requirements in first letter. Midwest city. Address Key #85-A, Heating, Piping & Air Conditioning, 6 No. Michigan Ave., Chicago 2.

### *agents wanted*

Manufacturers agents to call on manufacturers and jobbers of heating and ventilating equipment for established manufacturers of indicators, switches, special switching devices, parts and accessories for heating and ventilating use. Liberal commissions and territories available to qualified representatives. Write experience, lines representing and territories now covering. Write Key #87-A, Heating, Piping & Air Conditioning, 6 No. Michigan Ave., Chicago 2.

### *lines wanted*

Manufacturers representative with good following Connecticut and Westchester County; eleven years experience; heating and cooling desires additional lines. Address Key #84-A, Heating, Piping & Air Conditioning, 6 No. Michigan Ave., Chicago 2.

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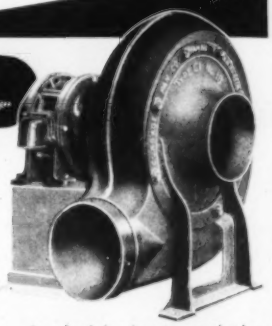
## TYPE CI EXHAUSTERS

**Capacities to 4000 CFM; Pressures to 20"**



Nothing shoddy or flimsy about these smaller Clarage industrial fans. They are O.K. for continuous service — built to the *same exacting standards* as the largest Clarage equipment.

Try them! . . . then you will readily understand why we call them "HEAVY-DUTY" — *and mean just that!*

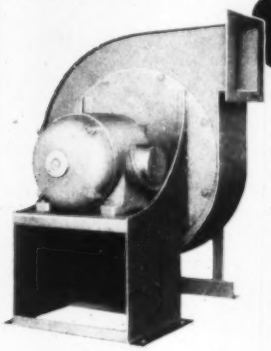
Use Clarage Type CI Exhausters for removing excess heat, dust, smoke, odors from any manufacturing operation — for supplying air to oil burners, as over-fire fans, etc. Use them for pneumatic conveying.

Fans also can be furnished gas tight, rubber covered, or with vulnerable parts of stainless steel or Monel — in fact, *in any construction* your special needs demand.

Standard fan housings and side plates are cast iron, long wearing, long resisting to corrosion. Heavy steel plate wheels are perfectly balanced. Fans in each of the 6 sizes can be V-belt or direct motor driven.

## TYPE O BLOWERS

**Capacities to 30,000 CFM; Pressures to 35"**



Another Clarage HEAVY-DUTY industrial fan! Use Type O Blowers for *high pressure* applications — supplying air to cupolas, gas and oil burners, etc. Fan housings and wheels are heavy steel plate equal to severest conditions. Built in 19 sizes, operating at speeds *most economical* for direct motor or steam turbine drive.

**WE ALSO MAKE:**

*LARGE INDUSTRIAL FANS*
*AIR CONDITIONING EQUIPMENT*
*AIR WASHERS UNIT HEATERS*

**CLARAGE FAN COMPANY** – *Kalamazoo, Michigan*

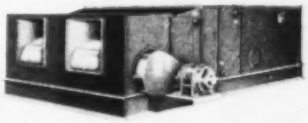
CLARAGE
—HEADQUARTERS for Air Handling and Conditioning Equipment

SEE OUR CATALOG IN SWEETS

*It pays to direct fan inquiries our way . . . phone Clarage office in your city, or write us at Kalamazoo.*

Application Engineering Offices in All Principal Cities

# Wherever an Air CLEAN-UP is Required . . .



## Clarage Capillary Conditioners Guarantee a Thorough Job!

Here are units that "wrap in a single package" the answers to (1) **maximum air cleanliness,** (2) **accurate temperature control,** (3) **close humidity regulation.**

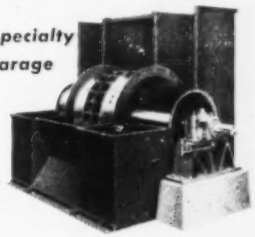
A Clarage Air Conditioner of this type includes a capillary cleaning section, pump, heating coils, fans, drive, and motor. Completely assembled — as either vertical or horizontal units — they install quickly and inexpensively. No additional parts or costly building alterations required. Seven sizes available — delivering from 1,800 to 20,000 cubic feet of air per minute.

Yes, where **thoroughly conditioned air** is vital to production, uniformity of product, health, or safety, there are many good reasons for choosing this modern equipment. Dependable performance is promised by scientific factory testing; **low first and operating costs** assured by Clarage's advanced engineering.

★ ★ ★

## MECHANICAL DRAFT FANS

***. . . a Specialty with Clarage***



**Recognized champions in the heavyweight class** are these Clarage Fans for induced and forced draft service.

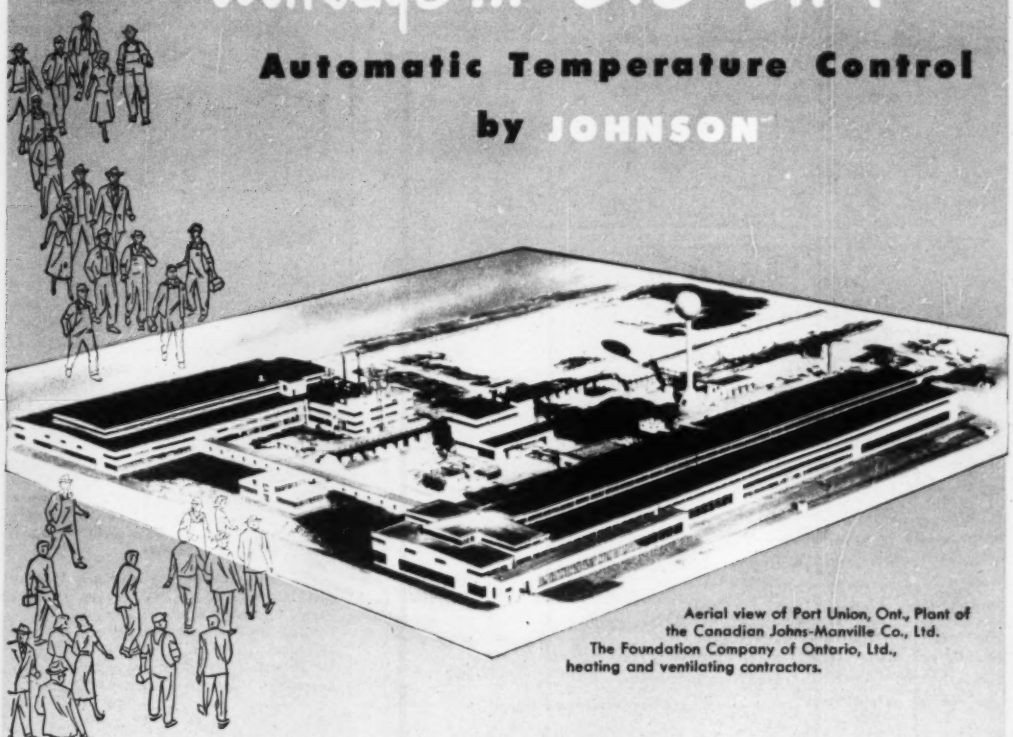
In thousands of central stations and industrial power plants Type RT Fans have proved — **and annually continue to prove** — their ability to withstand severest operating conditions. Shaft and bearings are EXTRA large; wheels EXTRA heavy; all points of stress HEAVILY reinforced!

Whenever air must be handled at high temperatures, high pressures, OR BOTH — for many industrial processes as well as in mechanical draft service — Type RT fans write outstanding performance records.

**CLARAGE FAN COMPANY, Kalamazoo, Mich.**

# Workday's ... "BIG LIFT"

## Automatic Temperature Control by JOHNSON

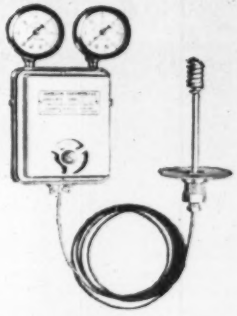


Aerial view of Port Union, Ont., Plant of the Canadian Johns-Manville Co., Ltd. The Foundation Company of Ontario, Ltd., heating and ventilating contractors.

Indoor vigor means more and better work. Today, management in industry welcomes the increased production, the higher quality of workmanship and the improved relations with employees which result from maintaining comfortable temperatures throughout working areas. Hundreds of industrial plants of every type depend upon Johnson Automatic Temperature Control to insure just the right temperature in every department.

At Johns-Manville's Port Union plant, more than forty Johnson Capillary Thermostats measure the temperature of the air handled by each of the large, suspended ventilating units. These thermostats automatically regulate Johnson Operators for the face-and-bypass dampers and Johnson Valves in each unit. JOHNSON *Low-Limit* Controllers insure that none of the units delivers uncomfortably cool air.

Set the stage for more work in your plant. Let a Johnson engineer cooperate with you in making plans and suggestions for the most economical solution of your temperature control problems. Such a conference is a Johnson courtesy—without obligating you, of course. Call a nearby Johnson engineer today. JOHNSON SERVICE COMPANY, Milwaukee 2, Wisconsin. Direct Branch Offices in Principal Cities.



Johnson T-800
Capillary Thermostat

**JOHNSON** *Automatic Temperature and Air Conditioning* **CONTROL**

DESIGN · MANUFACTURE · INSTALLATION · SINCE 1885